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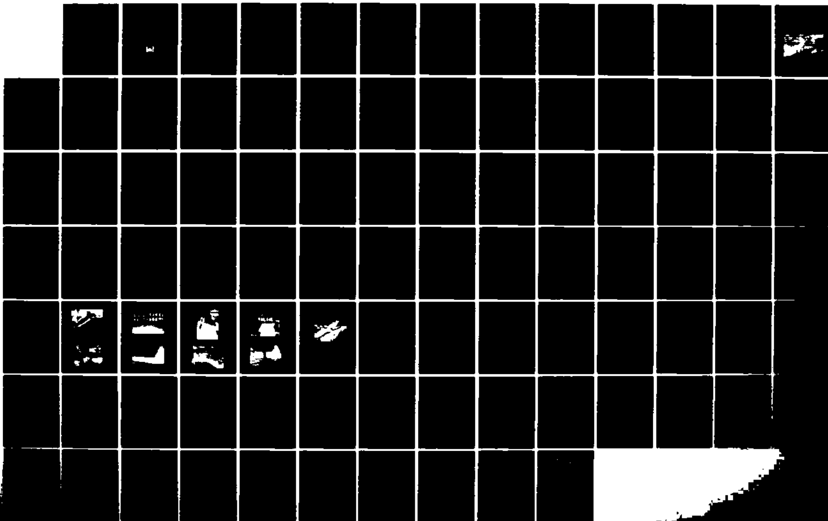

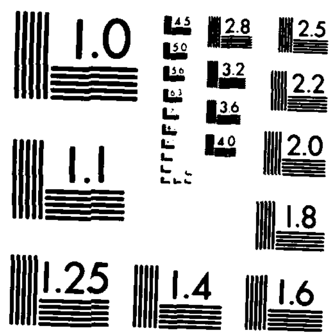

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AD-A156 411

CONNECTICUT RIVER BASIN
LEBANON, NEW HAMPSHIRE

MASCOMA DAM
NH 00155
NHWRB 134.09

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1980

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NH 00155	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Mascoma Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Lebanon, New Hampshire
Mascoma River

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The dam consists of two overflow type spillway sections separated by a waste gate strucuture. It is small in size with a high hazard potential. It is in poor condition at the present time. Further investigations are recommended to evaluate the condition of the timber crib spillway section and the waste gate structure. There are various remedial measures which should be undertaken by the owner.

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.:	NH 00155
NHWRB No.:	134.09
Name of Dam:	Mascoma Dam
Town:	Lebanon
County and State:	Sullivan County, New Hampshire
Stream:	Mascoma River
Date of Inspection:	May 6, 1980

BRIEF ASSESSMENT

The Mascoma Dam is located on the Mascoma River in Lebanon, New Hampshire approximately 6.1 miles downstream of Mascoma Lake. The dam consists of two overflow type spillway sections separated by a waste gate structure. The left spillway section is a reinforced concrete ogee section 123 feet long and 21.7 feet high. The right section is a rock filled, timber crib with a concrete cap. It is 123 feet long and 19 feet high. The two waste gates are each 6 feet high and 4 feet wide. The invert of these gates is 10 feet below the spillway crest. At the right abutment is a mill building with a 10.5 by 8 foot head gate which controls flow into the turbine.

The dam is owned by Mr. Garlin Hoskin of Lebanon, New Hampshire. It was designed and constructed for hydropower purposes. Power is not being generated at present, however, the owner is attempting to rehabilitate the power plant.

The drainage area of the dam covers 188 square miles and is made up primarily of rolling woodland with some development and pasture. The dam has a maximum impoundment of 210 acre feet. The dam is small in size and its hazard classification is HIGH since appreciable economic loss and the potential for loss of more than a few lives could result in the event of a dam failure.

Based on its small size and high hazard, the test flood for this dam could range from one-half the Probable Maximum Flood (PMF) to the Probable Maximum Flood. A flow of 10,000 cfs, used as a 500-year flood in a recent insurance study, is approximately the one-half PMF event and has been adopted as the test flood for this dam. Because of the insignificant surcharge storage, the resulting peak discharge is 10,000 cfs compared to a total spillway capacity of 11,930 cfs. The water surface would be at elevation 508.0 feet (msl) or 0.7 feet below the top of the dam for this flood. The combined spillways are capable of passing 100 percent of the adopted test flood.

The dam is in POOR condition at the present time. Further investigations are recommended to evaluate the condition of the timber crib spillway section and the waste gate structure. Remedial measures to be undertaken by the owner include: implementing annual maintenance and inspection programs, developing a

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The dam consists of two overflow type spillway sections separated by a waste gate strucuture. It is small in size with a high hazard potential. It is in poor condition at the present time. Further investigations are recommended to evaluate the condition of the timber crib spillway section and the waste gate structure. There are various remedial measures which should be undertaken by the owner.

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downstream warning system, clearing saplings and soil from behind waste gates, cleaning and lubricating waste gate operating mechanisms, and repairing concrete and masonry.

The recommendations and remedial measures outlined above should be implemented within one year of receipt of this report by the owner.

THE STATE OF NEW HAMPSHIRE
WILLIAM S. ZOINO
No. 3226
REGISTERED
PROFESSIONAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER
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N.H. Registration No. 3226

Nicholas A. Campagna, Jr.
California Registration No. 21006

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This Phase I Inspection Report on Mascoma Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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REPORT

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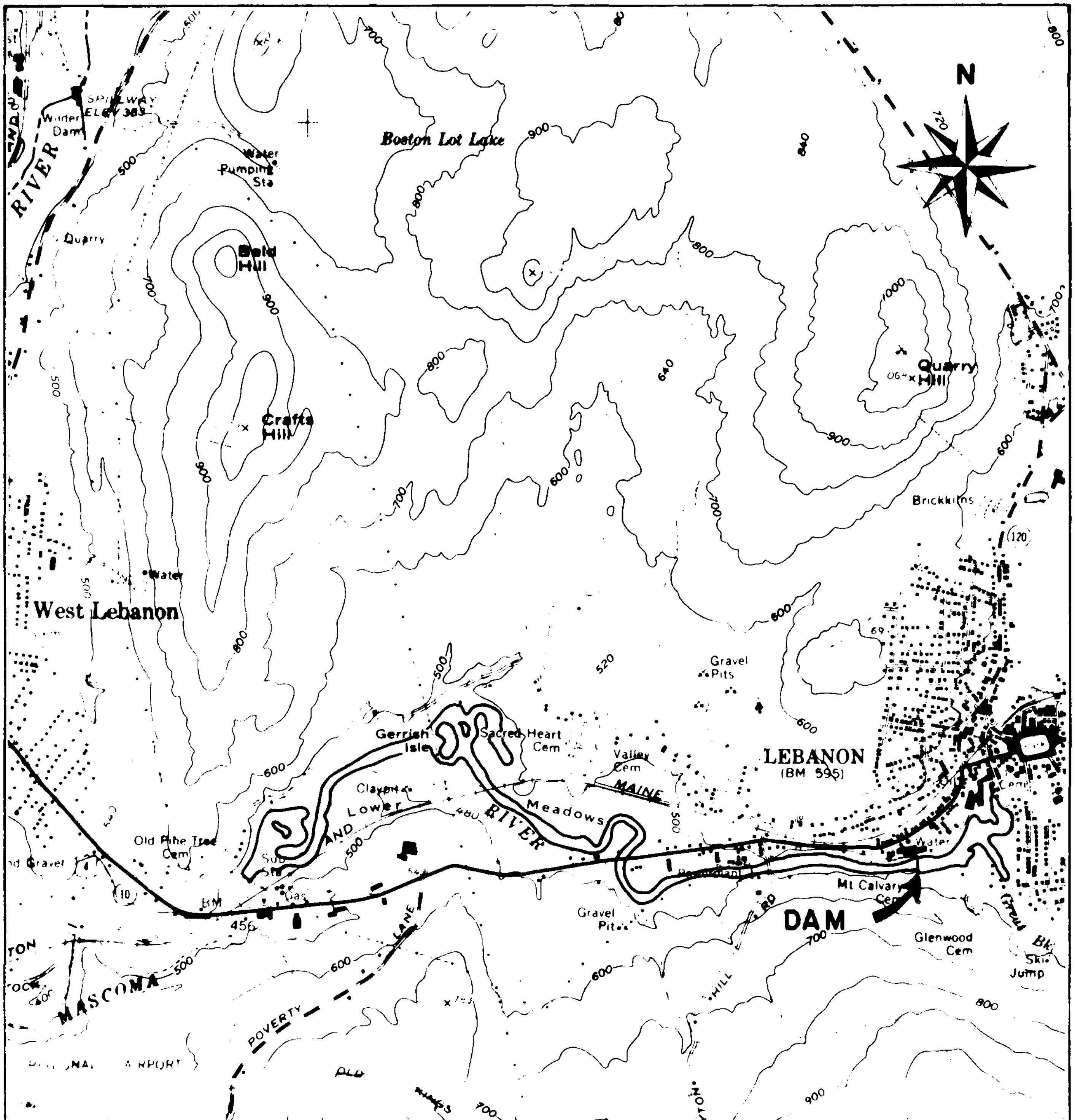
APPENDICES

Overview of Dam



SCALE

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FROM USGS HANOVER-VT., N.H. QUADRANGLE MAP

GOLDBERG ZOINO & ASSOCIATES, INC. GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS NEWTON UPPER FALLS, MASSACHUSETTS	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION PLAN

MASCOMA DAM LEBANON, NEW HAMPSHIRE

FILE No. 2605

SCALE AS SHOWN

DATE

National Dam Inspection Program

Phase I Inspection Report

Mascoma Dam

Section I: Project Information

1.1 General

(a) Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Goldberg-Zoino & Associates, Inc. (GZA) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to GZA under a letter of April 17, 1980 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW 33-80-C-0055 has been assigned by the Corps of Engineers for this work.

(b) Purpose

1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

3) Update, verify, and complete the National Inventory of Dams.

1.2 Description of Dam

(a) Location

The Mascoma Dam is located on the Mascoma River in Lebanon, New Hampshire approximately 6.1 miles downstream of Lake Mascoma. It can be reached from State Route 10 in Lebanon. The dam is shown on USGS Hanover, New Hampshire quadrangle at approximate coordinates N4338.3, W7215.4 (see location map on Page vi).

(b) Description of Dam and Appurtenances

The dam consists of two overflow spillway sections with a concrete

waste gate structure seperating the two. The right abutment is an old mill building with a head gate which controls flow into a turbine located within the mill building.

1) Left Spillway Section (See page B-2)

The left spillway section is a concrete ogee section approximately 123 feet long. This section is more recent construction than the rest of the dam. It was constructed around 1940 to replace an earth dike which was washed out in 1927 and again in 1938.

2) Right Spillway Section (See Pages B-2 & B-10)

The right spillway section is a rock filled timber crib with a concrete cap. It is approximately 123 feet long and 21.7 feet high. The crest width is 4 feet and the downstream face slopes at approximately 1 horizontal to 1 vertical.

3) Waste Gate Structure (See Pages B-2 & B-10)

This concrete faced, stone masonry structure stands between the two spillway sections. It is approximately 25 feet wide and 20 feet high. There are two waste gates each of which is 6 feet high and 4 feet wide. The invert of the waste gate openings is 10 feet below the crest of the spillways.

4) Power House (See Pages B-2, B-3, B-4, & B-7)

The powerhouse is part of a large mill building located at the right abutment. The head gate is 10.5 feet wide and 8 feet high and opens directly to a turbine used for the generation of electricity. The tailrace is located below the turbine and exits into the downstream channel approximately 10 feet downstream of the right downstream toe of the dam.

(c) Size Classification

The dam's maximum impoundment of 210 acre feet and height of 21.7 feet place it in the SMALL size category according to the Corps of Engineer's Recommended Guidelines.

(d) Hazard Potential Classification

The hazard potential classification for this dam is HIGH because of the appreciable economic losses and potential for loss of more than a few lives downstream in the event of dam failure. Section 5 of this report presents more detailed discussion of the hazard potential.

(e) Ownership

The dam was purchased by Mr. Garlin Hoskin of Hoskin Diversified Industries on April 1, 1980. It was previously owned by Mr. Raymond Daniels of Lebanon, New Hampshire. At one time the dam was owned by the American Woolen Company. The present owner's address is: Mr. Garlin Hoskin, 85 Mechanic Street, Lebanon, New Hampshire 03766. He can be reached by telephone at (603) 448-5118.

(f) Operator

The operation of the dam is controlled by the Owner, Mr. Garlin Hoskin of Lebanon, New Hampshire. He can be reached by telephone at (603) 448-5118.

(g) Purpose of the Dam

The purpose of the dam is to impound water for power generation. Presently, no power is being generated, although, the owner is attempting to rehabilitate the plant.

(h) Design and Construction History

The original design and date of construction are unknown. According to records of the New Hampshire Water Resources Board, the dam was rebuilt in 1925. The dike at the left side was washed out in 1927 and again in 1938. It was replaced with a concrete ogee spillway section sometime prior to 1940. The headgate was replaced in 1979.

(i) Normal Operating Procedure

The dam is normally self regulating. The waste gates and head gate are operable but are used only on an as needed basis.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers 188 square miles. It is made up of approximately 50 percent development and 50 percent rolling woodland and pasture.

(b) Discharge at Dam Site

1) Outlet Works

The outlet works consist of two waste gates and a head gate.

The waste gates are each 6 feet high and 4 feet wide. The head gate is 10.5 feet wide and 8 feet high. The invert of the waste gates is at elevation 492.7 feet (msl).

2) Maximum Known Flood

The maximum known flood at this dam site occurred in March of 1936. The flow during this flood is estimated to have been approximately 6800 cfs.

3) Ungated Spillway Capacity at Top of Dam

The capacity of the spillways with the reservoir at top of dam elevation (508.7 feet msl) is 11,930 cfs.

4) Ungated Spillway Capacity at Test Flood

The capacity of the spillways with the reservoir at test flood elevation (508.0 feet msl) is 10,000 cfs.

5) Gated Spillway Capacity at Normal Pool

There are no gated spillways.

6) Gated Spillway Capacity at Test Flood

There are no gated spillways.

7) Total Spillway Capacity at Test Flood

The total spillway capacity at test flood elevation (508.0 feet msl) is 10,000 cfs.

8) Total Project Discharge at Top of Dam

The total project discharge at top of dam elevation (508.7 feet msl) is 11,930 cfs.

9) Total Project Discharge at Test Flood Elevation

The total project discharge at test flood elevation (508.0 feet msl) is 10,000 cfs.

(c) Elevation (feet above msl)

1) Streambed at toe of dam: approximately 487.0

2) Bottom of cutoff: Unknown

3) Maximum tailwater: Unknown

4) Recreation Pool: Approximately 502.7

5) Full flood control pool: Not applicable

6) Spillway crest: Approximately 502.7

7) Design surcharge: Unknown

8) Top of dam: 508.7

9) Test flood surcharge: 508.0

(d) Reservoir (length in feet)

This is a run of the river dam. For analysis purposes assume 3,000 feet.

(e) Storage (acre-feet)

1) Normal pool: 170

2) Flood control pool: Not applicable

3) Spillway crest pool: 170

4) Top of dam pool: 210

5) Test flood pool: 208

(f) Reservoir Surface (acres)

This is a run of the river dam. For analysis purposes assume 20 acres.

(g) Dam

1) Type: Gravity, overflow, timber crib with concrete cap on the right side and a concrete ogee section on the left.

2) Length: Approximately 300 feet

3) Height: Approximately 21.7 feet

4) Top width: Variable

5) Side slopes: Not applicable

6) Zoning: Not applicable

7) Impervious core: Not applicable

8) Cutoff: Unknown

9) Grout curtain: Unknown

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillway

1) Type:
Left: Reinforced concrete ogee
Right: Stone filled timber crib with concrete cap

2) Length of weir:
Left: 123 feet
Right: 123 feet

3) Crest elevation: 502.7 feet (msl)

4) Gates: Spillways not equipped with gates

5) Upstream channel: Mascoma river channel

6) Downstream channel: Mascoma river channel

(j) Regulating Outlets

The regulating outlet consists of two rectangular sluiceways, each of which is 4 feet wide and 6 feet high and equipped with a wheel operated sluice gate. The invert of these gates is at elevation 492.7 feet (msl). These gates are normally closed.

Section 2: Engineering Data

2.1 Design Data

None of the original design drawings or calculations are available for this dam. Significantly lacking are data concerning the length and depth of any cutoff and the foundation conditions.

2.2 Construction Records

No construction records are available for this dam.

2.3 Operational Records

No operational records are available for this dam.

2.4 Evaluation of Data

(a) Availability

The lack of detailed design and construction data warrants an unsatisfactory assessment for availability.

(b) Adequacy

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment of the dam is based primarily on the visual inspection, past performance and sound engineering judgement.

(c) Validity

Since the observations of the inspection team generally confirm the information contained in the records of the New Hampshire Water Resources Board, a satisfactory evaluation for validity is indicated.

Section 3: Visual Observations

3.1 Findings

(a) General

The Mascoma Dam is in POOR condition at the present time.

(b) Dam

1) Left Abutment

This is an "L" shaped gravity structure. Its upper portion is located parallel to the spillway and acts as a cut-off wall and is approximately 21 feet long. The portion of the abutment normal to the spillway is a stepped structure with an overall length of 23 feet. The top of this structure is 7 feet above crest level. With the exception of a 1/4 inch traverse crack on the top of this abutment, this structure is in good condition. This crack was caused by differential settlement. There was no other evidence of cracks, spalls or efflorescence.

2) Left Spillway Section (See photos 9 & overview)

This structure has a crest approximately 4 feet wide. Pipe stanchion sockets are located approximately every 2 feet over the length of the crest, A concrete energy dissipating platform is located at the base of the right two-thirds of the spillway section. The purpose of this dissipating structure is to direct the overflows away from the dividing island. There is a considerable degree of erosion on the spillway's downstream face which can be attributed to ice damage and cavitation. A full length horizontal construction joint located 12 inches below the spillway crest has opened up to a depth of 1 inch. The energy dissipating platform has been subjected to the same degree of surface erosion as the downstream face of the spillway.

3) Waste Gate Structure (See photos 5, 6, 7, 8, & 9)

The left wall of the structure consists of dry stone masonry, 18 inches wide, faced with a concrete buttress, approximately 2 feet wide, located at the interface with the left spillway. This wall is in very poor condition. Approximately 20 feet of the stone wall has been breached and approximately 20 per cent of the wall has been undermined. The upstream corner of this concrete buttress wall located in the impoundment pool has eroded for approximately 18 inches above the spillway crest. This erosion is up to 6 inches deep and can be attributed to ice damage. There is considerable

spalling on the sloping top surface of this wall. This spalling is up to 6 inches deep. The face of the wall has spalled over 10% of its surface area. The spalling can be attributed to moisture intrusion subjected to alternate freeze and thaw cycles. A horizontal construction joint, which is located at mid height of the wall, has opened up to 2 inches in width and depth.

The right wall consists of dry stone masonry faced and capped with concrete and is 4 feet wide. This wall has been undermined, stones displaced and has been subjected to differential settlement. A void at the base of this wall is approximately 4 feet square. There are three major cracks in this wall. One crack is approximately 12 inches wide at the top and the end of the wall has rotated away from and leaning inward from the main structure.

The sluiceway outlets are 6 feet wide and 4 feet high. Saplings and other vegetative growth flourishes between the walls and the sluicegate outlets. The concrete invert of this sluicegate outlets has completely eroded exposing reinforcing steel and timber supports. The remains of the invert slab is also undermined. The bases of the end walls and dividing walls of the outlet structure are eroded up to 4 inches in height and up to 6 feet in length. The downstream side of the gate structure exhibits a high degree of spalls, open horizontal construction joints and a high degree of efflorescence. The spalling can be attributed to moisture intrusion subjected to alternate freeze and thaw cycles. Seepage is in evidence between the concrete end walls of the outlet structure and the dry stone masonry walls.

The top upstream right and left corners have been subjected to a high degree of spalling. This spalling is in excess of 6 inches in depth. The concrete platform which supports the gate bench stands is cantilevered over the impoundment pool by approximately 3 feet by means of 4 concrete brackets. The platform itself is in good condition.

The manually operated gate mechanisms consist of hand wheels and worm gears which actuate the rack gears on the timber stems. The operating mechanisms are severely rusted. In 1978 they were raised for a height of 3 inches with considerable effort. The timber sluice gates are in good condition and well seated with minor seepage flowing around the gates.

4) <u>Right Spillway Section</u> (See photos 1 & 4)

This structure is in deplorable condition as evidenced by severe erosion, exposure of formerly concrete faced timber cribbing and settlement. There is a large horizontal crack and settlement over the entire downstream face of the spillway 2 to 3 feet below the crest. In addition to the foregoing there are numerous horizontal cracks and holes resulting from cavitation.

Approximately 20 feet of the left end of this structure has been subject to such a high degree of cavitation and ice damage that large rubble stones have been exposed. The entire downstream sloping surface has settled in excess of 6 inches and possibly in excess of 12 inches. The actual degree of settlement could not be determined due to the overflows. A 5 foot wide concrete faced platform supported on a timber crib is located on the downstream end of this structure. The top if this platform is approximately 4 feet above the tailrace channel. The concrete surface has been subjected to considerable erosion which can be attributed to ice damage. The downstream end of this concrete platform has been shattered exposing the timber crib. Observations have revealed that the crest is not level; the left portion being lower than the right. It was also observed that the right end of the downstream platform is lower than the left.

The crest is approximately 4 feet wide and pipe sockets for flashboard stanchions are located approximately every 3 feet over its entire length.

5) Right Abutment (See photos 1 & 2)

The right abutment is a stepped structure. The main portion of this structure including the upstream training wall to the right of the forebay entrance is 4 feet 2 inches above the spillway crest. The abutment is 20 feet long and is laid out on a skew of 45 degrees away from the spillway axis. This structure extends 4 feet upstream into the impoundment pool and forms the left forebay entrance wall. The forebay entrance is 11 feet wide and is spanned by a 5 foot wide wood planked platform. The upstream training wall adjacent to the right bank consists of a concrete faced stone masonry structure. The downstream abutment extension, which has a sloping surface, terminates adjacent to the tailraice outlets from this building. The interface between this portion of the abutment and the spillway has eroded up to 12 inches in width and 12 inches in depth and can be attributed to cavitation. The upstream extension of the right abutment has been subjected to diagonal and horizontal random cracking and is suspected of being a concrete facing over stone masonry. The face of the abutment has spalled over 25% of its surface area. Furthermore it has been subjected to random cracking and efflorescence. The concrete is surface stained. The upstream training wall has spalled at the water line for a height of 18 inches above the water level. These spalls are approximately 15 and 10 feet long and approximately 8 inches deep. Additional spalled sections of concrete have pulled away from the stone and are supported by the tensile strength of the concrete. Random cracking is also prevalent over the face of this wall.

A sloping, galvanized steel trash rack is located immeditaley upstream of the timber platform opposite the forebay entrance. The platform and trash rack are in good condition. A chain link fence

located around the perimeter of the right abutment and the upstream training wall is in good condition.

A 5 foot high concrete platform supporting the head gate operating mechanism spans over the forebay entrance adjacent to the mill building wall. The top of this platform has spalled up to 3 inches in depth over 25% of its surface area and may be contributed to moisture intrusion subjected to alternate freeze and thaw cycles.

The head gate lifting mechanism consists of a series of wheel operated gears which actuate rack gears fastened to two gate stems. The entire assembly is rusted, however there is evidence of oiling and it is operable. The timber gate stems are reinforced with steel plates and are in good condition. The gate, which is submerged, is approximately 11 feet 8 inches wide and 6 to 7 feet high.

The right downstream retaining wall serves as the concrete foundation for the brick mill building. There are six penetrations through this wall. Two of the penetrations which are located immediately downstream of the spillway are 6 feet wide and are the power generating tailrace outlets. The other wall penetrations are drain outlets. Spalls up to 10 square feet in surface area are located at random locations along the wall. It is estimated that these spalls are up to 3 inches deep.

(c) Reservoir Area (see overview photo)

The reservoir area is the Mascoma River channel. It appears to be stable and in good condition.

(d) Downstream Channel (see overview photo)

The downstream channel is the Mascoma River channel. It appears to be stable and in good condition.

3.2 Evaluation

The dam and its appurtenant structures are generally in poor condition. The problem areas noted during the visual inspection are listed as follows:

(a) Severe cracking and toppling of the training walls and general poor condition of the waste gate structure.

(b) Severe erosion and general poor condition of the right timber crib spillway section.

(c) Saplings, brush, and soil accumulated behind the waste gates.

Section 4: Operational and Maintenance Procedures

4.1 Operational Procedures

(a) General

No written operational procedures exist for this dam. The dam is normally self regulating. The waste gates are operated by the owner on an as-needed basis.

(b) Description of any Warning System in Effect

There is no warning system in effect.

4.2 Maintenance Procedures

(a) General

No maintenance program exists for the dam. Maintenance is accomplished on an as-needed basis.

(b) Operating Facilities

No maintenance program exists and maintenance is performed infrequently.

4.3 Evaluation

Additional emphasis on routine maintenance will assist the Owner in assuring the long-term safety of the dam and operating facilities. A formal, written, downstream emergency warning system should be developed for this dam.

Section 5: Evaluation of Hydraulic/Hydrologic Features

5.1 General

The Mascoma Dam is a timber crib structure on the Mascoma River in Lebanon, New Hampshire. It was reconstructed in 1925 to supply hydroelectric power for use in nearby mill operations. This use of the dam has since been discontinued, although the owner is attempting to rehabilitate the plant.

The Mascoma River watershed is of rolling to mountainous terrain, mostly forested but including a sizable portion of pasture and field as well as some developed areas primarily in Lebanon. Additionally there is substantial hydrologic storage in the watershed provided by numerous ponds and reservoirs, the most important of which is Mascoma Lake. The drainage area at the Mascoma Dam is 188 square miles.

The Mascoma Dam is a run-of-the-river dam with two separate overflow weir spillway sections separated by a wastegate structure. A timber-crib structure, encased in concrete, forms the spillway section crossing the main (deepest) stream channel, while a concrete ogee section extends to the left across a secondary channel. The two spillway sections have equal crest lengths. The wastegate structure includes two wastegates, each 4 feet wide by 6 feet high.

At the right abutment of the dam is a mill building which lines the stream just below the dam. A gated inlet just upstream of the mill building leads to power generating equipment inside. The building's windows facing the stream are roughly 11 feet above the streambed. A single story expansion of this building downstream sits on the right stream bank and could be subjected to flood damage. The floor level is approximately 9 feet above the streambed.

Outflows from the two spillway sections combine in a moderately sloped sandy bottom stream channel shortly below the dam. The Mascoma River channel then becomes somewhat narrower, and the gradient steeper, a few hundred feet downstream of the dam. For about the next mile downstream, the channel has a moderate to steep slope, with a rock and boulder-strewn streambed. There is a narrow flood plain at the right bank, about 80 feet to 100 feet wide and elevated roughly 10 feet above the streambed.

About 750 feet downstream of the dam in the flood plain at the right bank is a warehouse and a storage area for construction equipment. The floor of the warehouse is approximately 12 feet above the streambed.

The next structures of interest are the Plant No. 1 Dam and the Slayton Hill Road Bridge, about 1/2 mile downstream of Mascoma Dam. Plant No. 1 Dam, the subject of a separate inspection report, is a run-of-the-river dam approximately 12 feet high. It is formed by timber decking which spans concrete buttresses. The timber is presently in poor condition. Slayton Hill Road crosses the Mascoma River approximately 150 feet upstream of the Plant No. 1 Dam. The bridge is well elevated, with low chord some 12 feet above the crest of the Plant No. 1 Dam, and has a broad opening. This bridge should not

be subject to flood damage.

For the first quarter mile or so downstream of the Plant No. 1 Dam there is an extensive flood plain at the left bank as well as a narrow flood plain at the right bank. There are a number of structures near the right bank along this reach, including a power sub-station and commercial/warehouse buildings. A little futher downstream is a restaurant. The lowest of these structures is approximately 14 feet above the streambed.

For the next quarter mile reach down to the Mechanic Street crossing the left bank of the river becomes very confining with the broad flood plain extending from the right bank.

Mechanic Street crosses the river about one-half mile downstream to the Plant No. 1 Dam (one mile downstream of the Mascoma Dam). The bridge has an opening about 75 feet wide and 12 feet high. There are houses and businesses in the flood plain near Mechanic Street. Those most subject to flood damage are a light industrial building situated roughly 10 feet above the streambed and a garage 10-12 feet above the streambed.

Further downstream, the Mascoma River takes on a milder gradient with a sandy bottom channel and lower velocity flows. Including Interstate-89 and the B & M Railroad, which cross the river on well elevated bridges, there appear to be no structures threatened by flood damage for the next 1-1/2 miles.

5.2 Design Data

Data sources available for the Mascoma Dam include prior inventory and inspection reports. The New Hampshire Water Control Commission's "Data on Dams in New Hampshire" (3 January 1939) and "Data on Water Power Developments in New Hampshire" (3 January 1939) along with the New Hampshire Water Resources Board's, "Inventory of Dams and Water Power Developments," (8 September 1937) were utilized in this study.

None of the original hydrologic and hydraulic design records are available.

5.3 Experience Data

A New Hampshire Water Control Commission questionnaire completed by the dam's owner concerning flood levels experienced during September 21 through 24, 1938 is available. The reported peak was about 8 feet above the spillway crest, with the river cutting its way around the end of the dam. However, the spillway crest has been considerably lengthened since that time.

The U.S.G.S. operates a water stage recorder on the Mascoma River at Mascoma, New Hampshire, approximately 5.2 miles upstream of the Mascoma Dam. The record is continuous from August 1923 to date. The maximum recorded flood at this gauge took place in March, 1936 with a peak discharge of 5840 cfs. After adjustment for the larger drainage area, the corresponding peak discharge at the Mascoma Dam would be about 6800 cfs.

A recent Flood Insurance Study (FIS) of the City of Lebanon included an analysis of the Mascoma gauge data to develop 10, 50, 100, and 500-year peak discharges for the Mascoma River in Lebanon. These are available in an FIS report dated January 1975. The peak 1936 discharge at Mascoma gauge of 5840 cfs is approximately equal to the 50-year discharge of 5900 cfs.

5.4 Test Flood Analysis

The hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires using the discharge and storage characteristics of the structure to evaluate the impact of an appropriately-sized Test Flood. None of the original hydraulic and hydrologic design records are available for use in this study.

Guidelines for establishing a recommended Test Flood based on the size and hazard classifications of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of less than 1000 acre-feet and height of less than 40 feet classify this dam as a SMALL structure.

The hazard potential for the Mascoma Dam is considered to fall within the HIGH category. This is based mainly on the possibility of causing serious flood damage and possible loss of more than a few lives at the mill building just downstream with a possibility of more than a few lives lost in the event of a dam failure. Additionally, dam failure with the river at an extremely high stage could cause an increase of flooding at two or more structures in the flood plain near Mechanic Street, one mile downstream.

As Shown in Table 3 of the Corps of Engineers' "Recommended Guidelines," the appropriate Test Flood for a dam classified as SMALL in size with HIGH hazard potential would be between one-half of the Probable Maximum Flood and the Probable Maximum Flood (PMF). Where a range of values is indicated for the Test Flood, the magnitude of the flood should be related to the hazard potential. There is a possible threat to the lives of workers in the mill building just below the dam should failure occur under normal flow conditions. However, under extreme (test flood type)conditions, flooding at the mill would not allow the presence of workers there. Therefore the smaller Test Flood approximately equal to one-half of the Probable Maximum Flood at the dam was selected.

The results of a previous flood insurance study for this river provide estimated values for the 10, 50, 100, and 500-year discharges at the Mascoma Dam. These were computed using a log-Pearson Type III statistical analysis of peak discharges at a stream gauge 5.2 miles upstream of the dam. In order to approximate a one-half PMF event, the 500-year peak discharge of 10,000 cfs has been adopted as the test flood for this dam. The surcharge storage volume for this dam is too small in relation to the size of the watershed to have a significant attenuating effect on the flood peak.

A stage-discharge curve has been developed by defining discharge as the sum of flow over the spillway and over the abutments. The calculations determining the curve are documented in Appendix D.

Using this stage-discharge curve, the peak Test Flood discharge of 10,000 cfs would result in a maximum stage of 5.3 feet above the spillway crest, or 0.7 feet below the top of the abutments walls.

5.5 Dam Failure Analysis

The peak outflow at Mascoma Dam that would result from dam failure is estimated using the procedure suggested in the Corps of Engineers, New England Division's April 1978 "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs." Two different cases were considered: failure with a normal pool and failure with a "maximum" pool.

In the first case, failure is assumed to occur with an average discharge condition at the dam. Just prior to failure, with a 260 cfs outflow, the pool would be 0.5 feet above the spillway crest and the tailwater level estimated to be 14.5 feet below the headwater level. Assuming a 100 foot gap is opened in the dam, the peak outflow through this gap and over the remainder of the spillway would be 9,540 cfs.

In the Mascoma River downstream of the dam, this outflow would result in a depth of flow 11 to 12 feet, 9.5 :o 10.5 feet above the 1.5 foot depth assumed to exist prior to failure. Such a flood would reach the level of the windows in the mill building which lines the stream just below the dam. Flooding 2-3 feet deep would be experienced at the downstream extension of this building. Minor flood damage might be incurred at the warehouse and construction equipment lot 750 feet downstream of the dam.

Following essentially the "Rule of Thumb Guidelines," it is estimated that at the end of the first 0.5 mile reach downstream of the dam, near the Plant No. 1 Dam, the dam failure flood peak would be attenuated to 7,060 cfs. The timber decking of the Plant No. 1 Dam, already in poor shape, might be damaged by such a flood. The concrete abutments and buttresses probably would not be harmed. This dam is listed in a separate inspection report as a low hazard dam. Failure of this dam under these conditions would add only a small increment to the flood depths that would be experienced downstream.

The 7000 cfs dam failure discharge would have a depth of about 10 feet downstream of the Plant No. 1 Dam. Structures near the right bank in this vicinity are sufficiently elevated to escape flood damage.

Further attenuation of the flood wave would take place in the 0.5 mile reach from the Plant No. 1 Dam to Mechanic Street. Using the same storage routing technique, it is estimated that the discharge at the end of this reach would be 5760 cfs. The resulting flood depth would be roughly 9 feet, not enough to cause serious damage (if any) to the low lying structures near Mechanic Street.

Over the next 1-1/2 mile reach of the Mascoma River, in which there are no structures threatened by flooding, the dam failure flood wave would be so attenuated that it should not be a hazard further downstream.

In the second case, failure is assumed to occur with the pool at the level of the abutments. This is 21.5 feet above the natural streambed level. Just prior to failure, the normal outflow over the spillway would be 11,900 cfs, with a tailwater level estimated to be 8.5 feet below the headwater level. Assuming a 100-foot gap is opened in the dam, the peak failure outflow through this gap and over the remainder of the spillway would be 16,100 cfs.

The result would be about a 2 foot increase to the already seriously damaging flood level just below the dam, from 13 feet to 15 feet. A little further downstream, where there is a flood plain area at the right bank, dam failure would cause flood levels to increase by a little more than 1 foot. Further downstream, attenuation would reduce the increment of flooding due to dam failure to 1 foot or less.

The mill building at the Mascoma Dam, the warehouse and construction equipment lot 750 feet downstream, and low lying structures near Mechanic Street would all suffer serious flood damage prior to dam failure, and would experience an increase of flooding 1-2 feet or less as a result of dam failure.

The results of the hydrologic and hydraulic calculations indicate that the spillway capacity is sufficient to pass the recommended Test Flood. Failure of this dam would result in serious flooding at the mill building just downstream, and under extreme conditions, an increase in flooding at two structures in the flood plain one mile downstream.

Section 6: Structural Stability

6.1 Evaluation of Structural Stability

(a) Visual Observations

1) General

The field investigations revealed that the right spillway section and the waste gate structure have serious structural deficiencies which warrant further investigations.

2) Right Spillway Section

The concrete cap on this rock filled timber crib structure has been seriously eroded to the extent that the rock fill has been exposed. Observations also revealed that the downstream sloping surface has settled at least 6 inches. Furthermore the crest is no longer level; the left portion being lower than the right. The right end of the downstream platform has also settled.

3) Waste Gate Structure

The right wall of this structure (adjacent to the left end of the spillway section) has been seriously undermined. The concrete facing exhibits three major cracks indicative of differential settlement. The downstream end of this wall has rotated from the remainder of the wall and has tilted inward.

The supporting concrete foundations of the waste gate outlet are undermined and the outlet slab has eroded exposing a timber framed foundation. The structural stability of this structure is being jeapordized.

(b) Design and Construction Records

No plans or calculations of value to a stability assessment are available for this dam.

6.2 Design and Construction Data

No records of structural stability analyses are available for this dam.

6.3 Post Construction Changes

The original dam consisted of the timber crib spillway section, the waste gate structure, and an embankment to the left of the gate

structure. The embankment was washed away during flooding in 1927 and again in 1938. It was replaced with the concrete ogee spillway section sometime between 1938 and 1942.

6.4 Seismic Stability

The dam is located in seismic zone No. 2 and, in accordance with the recommended Phase I guidelines, does not warrant seismic analysis.

Section 7: Assessment, Recommendations and Remedial Measures

7.1 Dam Assessment

(a) Condition

The Mascoma Dam is in POOR condition at the present time. The right spillway should be either strengthened or reconstructed. The foundation of the waste gate structure should be strengthened. The right training wall should be underpinned and strengthened.

(b) Adequacy of Information

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment is based primarily on the visual inspection, past performance, and sound engineering judgement.

(c) Urgency

The recommendations and improvements contained herein should be implemented by the owner within one year of receipt of this Phase 1 report.

7.2 Recommendations

It is recommended that the services of a registered professional engineer be retained to:

(a) Draw down the impoundment pool to investigate the condition of the right spillway section and the right waste gate training wall.

(b) Prepare plans for strengthening or replacement of the right spillway section and right waste gate wall including repair of spalled concrete.

(c) Prepare plans for repairs, including underpinning if required, of the waste gate foundation walls. These plans should include the removal of the left wall downstream as it serves no useful purpose and is in poor condition.

(d) Investigate the source of seepage behind the waste gate structure and determine the proper method of sealing this seepage.

The owner should implement the findings of the above engineering studies.

7.3 Remedial Measures

It is recommended that the following remedial measures be undertaken by the owner:

(a) Clear all saplings, brush and organic soils behind the waste gate structure.

(b) Clean and lubricate waste gate operating mechanisms.

(c) Implement a program of annual technical inspections of the dam and its appurtenances including operation of all outlet works.

(d) Develop a plan for surveillance of the dam during and immediately after periods of heavy rainfall and a formal downstream emergency warning system for warning downstream officials in the event of an emergency.

(e) Implement and intensify a program of diligent and periodic maintenance.

7.4 Alternatives

There are no meaningful alternatives to the above recommendations.

APPENDIX A

VISUAL CHECKLIST WITH COMMENTS

Inspection Team Organization

DATE: May 6, 1980

PROJECT: NH 00155
Mascoma Dam
Lebanon, New Hampshire
NHWRB No. 134.09

WEATHER: Clear, warm

Inspection Team

Nicholas A. Campagna	Goldberg Zoino & Associates, Inc.	Team Captain
William S. Zoino	Goldberg Zoino & Associates, Inc.	Geotechnical
Jeffrey M. Hardin	Goldberg Zoino & Associates, Inc.	Geotechnical
Andrew Christo	Andrew Christo Engineers	Structures
Paul Razgha	Andrew Christo Engineers	Structures
Carl Razgha	Andrew Christo Engineers	Structures

Robert Fitzgerald and Richard Laramie of Resource Analysis Inc. performed the hydrologic inspection of this dam on April 24, 1980

New Hampshire Water Resources Board
Representative Present -- Mr. Pattu Kesavan

MASCOMA DAM

Lebanon, New Hampshire

MAY 6, 1980

NH 00155

CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
<u>Right Abutment</u>	PR	
Condition of Concrete		Good
Spalling		None noted
Erosion		None noted
Cracking		A vertical crack downstream of spillway
Rusting or staining of concrete		None noted
Visible reinforcing		None noted
Efflorescence		None noted
Seepage		None noted
<u>Left Spillway Section</u>		
Condition of concrete		Fair
Spalling		None noted
Erosion		Considerable on downstream face. Energy dissipating structure eroded in a similar fashion.
Cracking		A full length horizontal crack at construction joint 1" deep located 12" below crest
Rusting or staining of concrete		None noted
Visible reinforcing		None noted
Efflorescence		None noted
Seepage		None noted
<u>Waste Gate Structure</u>		
Condition of concrete	PR	Poor

CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Spalling	PR	Top surface of left buttress wall spalled up to 6" deep. The exposed face spalled over 10% of its surface area. Right end of gate structure spalled over 20% of surface area. Rear of gate structure spalled over 10% of surface area.
Erosion		Upstream left corner of gate structure eroded from crest up to 18" x 6" deep. Concrete inverts of sluicegate outlets completely eroded and undermined. Bases of end and dividing walls at outlet eroded 4" high and 6" deep.
Cracking		Left buttress exhibits horizontal crack (construction joint) opened up to 2". Three major cracks in right wall, one crack up to 12". End of wall rotated from and tilting inward from remainder of wall. Downstream side of gate structure has open horizontal construction joints.
Rusting of staining of concrete		Minor on vertical embedments.
Visible reinforcing		Exposed at concrete sluice gate outlet.
Efflorescence		Front, rear & sides of waste gate structure and face of right wall.
Undermining		Right wall undermined 4'x4'. Left wall over 20% of its length. Left wall breached for 20 feet.
Seepage	PR	Minor at interface of gate structure end walls.

CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
	PR	
Vegetation		Saplings, brush and organic matter adjacent to gate structure end walls.
Waste gates		Timber gates in good condition. Gate mechanisms rusted, difficult to operate.
Right Spillway Section		
Condition of concrete		Poor
Spalling		None noted
Erosion		Entire downstream face including platform heavily eroded. Stone fill exposed.
Cracking		Continuous horizontal crack 2 to 3' below crest. Down-stream slope settled 6 to 12".
Rusting or staining of concrete		None noted
Visible reinforcing		None noted
Efflorescence		None noted
Undermining		Spillway has settled.
Seepage		Could not be observed but is suspect.
Right Abutment		
Condition of concrete		Fair
Spalling		Considerable. Front face of abutment, up to 25% -- up to 3" deep. Upstream training wall up to 18" above water level 15' & 10' long & 8" deep. 25% of top of sluice gate platform up to 3" deep.
Erosion	PR	Entire interface of abutment

MASCOMA DAM

Lebanon, New Hampshire

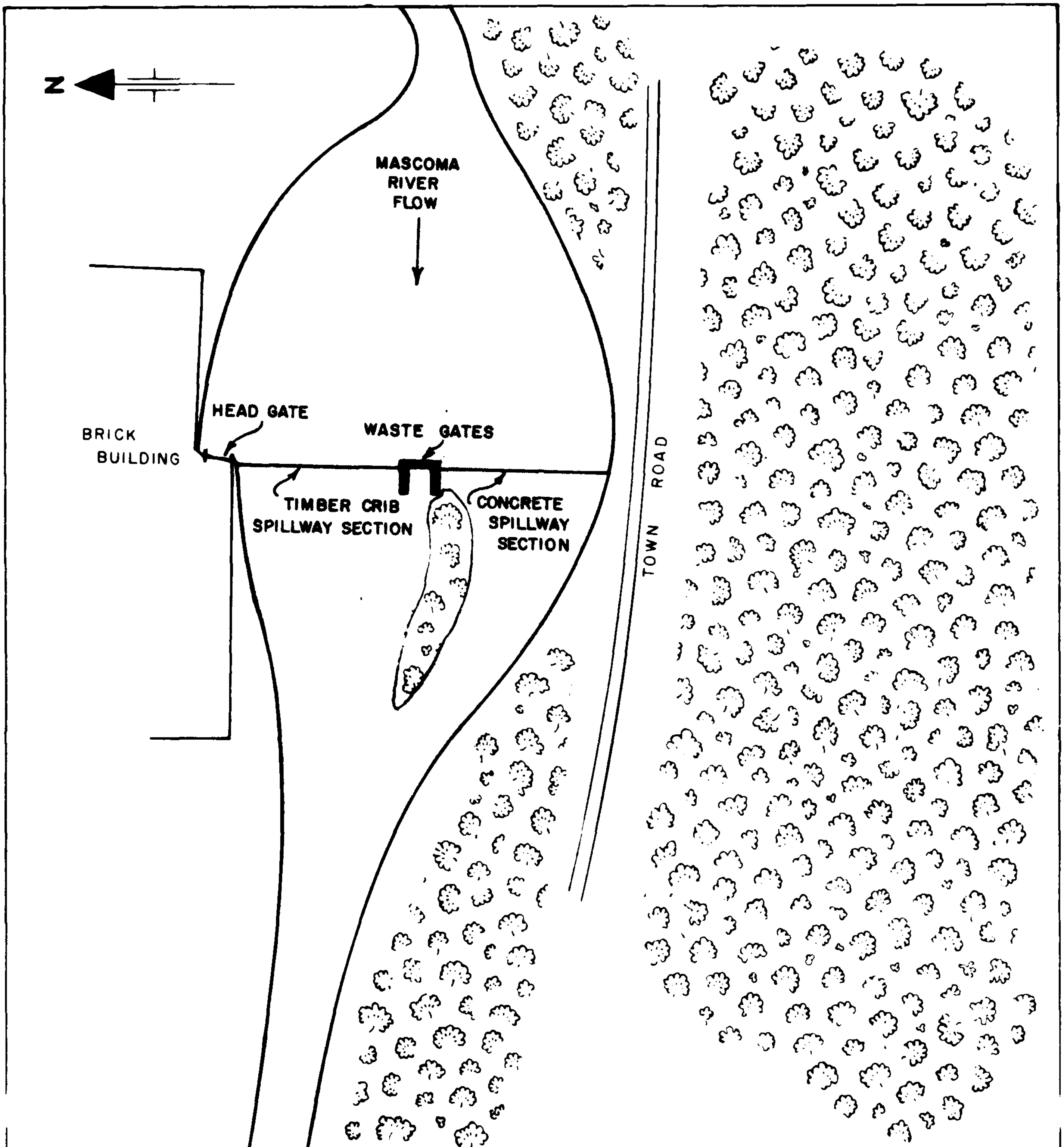
MAY 6, 1980

NH 00155

CHECKLISTS FOR VISUAL INSPECTION		
AREA EVALUATED	BY	CONDITION & REMARKS
	PR	and spillway 12" wide x 12" deep.
Cracking		Upstream wall, upstream abutment extension and face of abutment subjected to random cracking.
Rusting or staining of concrete		Minor
Visible reinforcing		None noted
Efflorescence		Faces of abutment and upstream wall
Head gate		Mechanism rusted but operable. Timber stems in good condition.
Trash rack		Good condition
Timber walkway		Good condition
Chain link fence	PR	Good condition

APPENDIX B

ENGINEERING DATA



GOLDBERG ZOINO & ASSOCIATES, INC
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

US ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SITE PLAN

FILE No 2605

MASCOMA DAM

LEBANON, NEW HAMPSHIRE

SCALE 1" = 100' (APPROXIMATE)

DATE JUNE 1980

NEW HAMPSHIRE WATER RESOURCES BOARD

QUESTIONNAIRE

WATER POWER DEVELOPMENTS IN NEW HAMPSHIRE

MASCOMA MILLS

American Woolen Co
Lebanon N. H.

Gentlemen:

We maintain in this office a list of the water power installations in New Hampshire and are frequently receiving inquiries concerning these installations. We are, therefore, bringing this information up to date, and request your cooperation by filling in the questionnaire below with data on your development and return it to us in the enclosed stamped envelope.

If the ownership has changed, will you please forward this questionnaire to the present owners.

Very truly yours,

Walter G White
Acting Chairman

Dam No. 134.09 Location Lebanon ~~Brook~~ River at Mascoma

1. Will you please check or correct:

	Our Data	Your Corrections
Head - feet	15	
Capacity	750	
Wheel - H.P.	340	
Generator - K.W.	150	

2. Is the power plant in operation? Yes
3. If not, is the equipment in operable condition? ______
4. Is the dam in good repair? Yes

Signed: [signature]

Date January 30, 1948

Form E80

NEW HAMPSHIRE WATER RESOURCES BOARD

QUESTIONNAIRE

WATER POWERS OF NEW HAMPSHIRE

American Woolen Co.
Lebanon
New Hampshire

Gentlemen:

We maintain in this office a list of the water power installations in New Hampshire. In recent months we have had several inquiries concerning the water power installations in the State and have found that our information is in some cases out of date.

We are, therefore, bringing this information up to date and request your cooperation by filling in the questionnaire below with data on your development, and return it to us in the enclosed stamped envelope.

Very truly yours,

R. S. Holmgren

RSH:GMB
Encl.

Richard S. Holmgren
Chief Engineer

Dam No. 134.09 : Location: Masooma River at Lebanon

1. Will you please check or correct:

	Our Data	Your Corrections
Drainage Area - Sq.Mi.	188	
Head - feet	16	15 ft
Capacity	750	
Wheel - H.P.		340 HP
Generator - K.W.	150	mech. drive

2. Is the power plant now in operation? Yes
3. If not, is the equipment in operable condition? —
4. Is the dam in good repair? Yes

(Signed) J.A. Campbell
Supervising Engineer

Date 7.14.42

7204

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 134.09

Town Lebanon : County Sullivan

Stream Mascoma R.

Basin-Primary Conn R : Secondary Mascoma R

Local Name Mascoma Dam

Coordinates—Lat. 43° 40' - 1070.0 : Long. 72° 15' - 2100

GENERAL DATA

Drainage area: Controlled .... Sq. Mi.: Uncontrolled .... Sq. Mi.: Total 188 Sq. Mi.

Overall length of dam 161.5 ft.: Date of Construction rebuilt 1925

Height: Stream bed to highest elev. 18.5 ft.: Max. Structure 14.5 + 13.3 ft.

Cost—Dam .... : Reservoir ....

DESCRIPTION Timber Crib- Planks encased in Concrete— Concrete Cap—

Waste Gates

Type ....

Number 2 : Size 4 ft. high x 6 ft. wide

Elevation Invert 10' : Total Area 48 sq. ft.

Hoist ....

Waste Gates Conduit

Number .... : Materials ....

Size .... ft.: Length .... ft.: Area .... sq. ft.

Embankment

Type ....

Height—Max. .... ft.: Min. .... ft.

Top—Width .... : Elev. .... ft.

Slopes—Upstream .... on .... : Downstream .... on ....

Length—Right of Spillway .... : Left of Spillway ....

Spillway

Materials of Construction ....

Length—Total 123 ft.: Net 133 ft.

Height of permanent section—max. 14.5 ft.: Min. .... ft.

Flashboards—Type .... : Height 2 ft.

Elevation—Permanent Crest 502.7 : Top of Flashboard ....

Flood Capacity 3630 cfs.: 19.3 cfs/sq. mi.

Abutments

Materials: ....

Freeboard: Max. 4 ft.: Min. .... ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER American Woolen Co

Condition Good

REMARKS Condition Good

Use— Power for Woolen Mill

Tabulation By A A N & R L T Date Jan 3, 1939

7206

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON WATER POWER DEVELOPMENTS IN NEW HAMPSHIRE

LOCATION — **AT DAM NO.** 134.09

Town: Lebanon; County: Sullivan
Stream: Mascoma R
Basin-Primary: Connecticut; Secondary: Mascoma R
Local Name: Mascoma Dam

GENERAL DATA

Head-Max. 16.04 ft.: Min. .... ft.: Ave. 15 ft.
Date of Construction ....: Use of Power: for Woolen Mill
Pondage .... ac. ft.: Storage .... ac. ft.

DESCRIPTION

Racks

Size of Rack Opening ....
Size of Bar ....: Material ....
Area: Gross .... Sq. Ft.: Net .... sq. ft.

Head Gates

Type ....
Number ....: Size 10 1/2 ft. high x 8 ft. wide
Elevation of Invert ....: Total Area .... sq. ft.
Hoist ....

Penstock

Number ....: Material ....
Size ....: Length ....

Turbines

Number 2: Makers 30' Hercules- horizontal 160 RPM
Rating HP. per unit 375: Total Capacity 750- HP.
Max. Dement C.F.S., per unit ....: Total .... cfs.

Drive

Type ....

Generator

Number ....
Make ....
Rating KW., per unit ....; Total Capacity .... K. W.

Exciter

Number ....: Make ....
Rating-per unit ....: Total Capacity .... K. W.

OUTPUT—KWHRS

19.......	........:	19.......	....
19.......	........:	19.......	....
19.......	........:	19.......	....
19.......	........:	19.......	....
19.......	........:	19.......	....

OWNER American Woolen Co

Tabulation By A A N & R L T Date Jan 3, 1939

7949

TOWN NO. 9 TOWN Lebanon, N. H. NO. 47 PAGE N 3

NAME OF COMPANY American Woolen Company

HOME ADDRESS 245 State St., Boston, Mass.

DRAINAGE AREA 181 SQ. MI. HEAD 16 FT.

RIVER Mascoma RATE SEC. FT. PER SQ. MI. 90% TIME 0.7

RESOURCES

FOR CENTRAL STATIONS		FOR ISOLATED INDUSTRIAL PLANTS	
WHEEL CAP. H. P.	PRIMARY H. P. 90% TIME	WHEEL CAP. H. P.	PRIMARY H. P. 90% TIME
		370	184.27

USES

FOR CENTRAL STATIONS		FOR ISOLATED INDUSTRIAL PLANTS		
K. V. A. CAPACITY	ANNUAL KW. H. OUTPUT	K. V. A. CAPACITY	ANNUAL KW. H. PROD. AND CONS. ELECT.	ANNUAL KW. H. PROD. AND CONS. MECH.

Rec'd 10/20/38

Jacobson	
Holmgren	✓
Palmer	
Return to	
Filed	
File No.	

WATER CONTROL COMMISSION

STATE OF NEW HAMPSHIRE

Concord, New Hampshire

October 14, 1938.

American Woolen Co.,
Lebanon N H

RE: Am Woolen Co Dam. W. C. C. No. 134.09

Gentlemen:

In order that we may determine the magnitude and extent of the flood of September 21-24 just passed, we are requesting the various dam owners in the State to supply us with the following information:

1. Was this dam injured? Ans. No
2. If so, to what extent? Ans. River cut way around the dam
3. Did all flashboards go out? Ans. No
4. What was the maximum height of water over the permanent crest of spillway? Ans. 8 Feet
5. At what day and hour did the maximum flood height reach your dam? Ans. Sept 22, about 12 noon
6. Any other interesting information regarding the flood or rain fall may be given on the back of this sheet, or attach sheets.

Will you please return this letter with as much information as you can give us as promptly as possible. A self-addressed envelope is attached hereto.

We thank you for your cooperation.

Very truly yours,

Richard S. Holmgren

Richard S. Holmgren
Chief Engineer

CDC:GMB
Enc.

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Connecticut NO. 134.09 {181 PSC

RIVER Mascoma MILES FROM MOUTH 4.65 D.A.SQ.MI. 168 AE

TOWN Lebanon OWNER American Woolen Co 189 USGS

LOCAL NAME OF DAM Mascoma Dam.

BUILT rebuilt 1925 DESCRIPTION ~~Concrete~~ AE ~~Timber PSC~~

Timber crib, planks removed + encased in Concrete. Earth fill on left bank river

POND AREA-ACRES DRAWDOWN FT. POND CAPACITY-ACRE FT.

HEIGHT-TOP TO BED OF STREAM-FT. ~~8~~ 18.5 MAX. MIN.

OVERALL LENGTH OF DAM-FT. ~~50~~ 161.5 MAX.FLOOD HEIGHT ABOVE CREST-FT.

PERMANENT CREST ELEV.U.S.G.S. 507.7 LOCAL GAGE 98

TAILWATER ELEV.U.S.G.S. 488.6 LOCAL GAGE

SPILLWAY LENGTHS-FT. ~~50~~ 123 FREEBOARD-FT. 4.0 rt 5.2 left.

FLASHBOARDS-TYPE,HEIGHT ABOVE CREST ~~3~~ 2.0

WASTE GATES-NO.	WIDTH	MAX.OPENING	DEPTH SILL BELOW CREST
2	6	4	10

REMARKS Condition ~~fair~~ good. Water leaks thru left wingwall
2G where masonry is cracked. Might wash around that end. Reason for earth dike was dispute about flowing low land owned by someone else.

POWER DEVELOPMENT

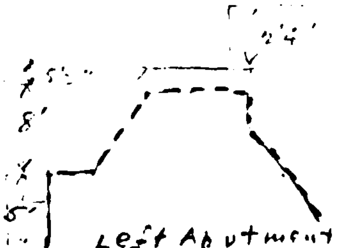
UNITS NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE
	~~300~~	~~16.3~~	~~AE~~		
	~~340~~	~~15~~	~~USGS list~~		
	~~370~~	~~16~~	~~PSC~~		
2	375 ea	16.04			30" Hercules horizontal 160 R.P.M.

USE Power for woolen Mill

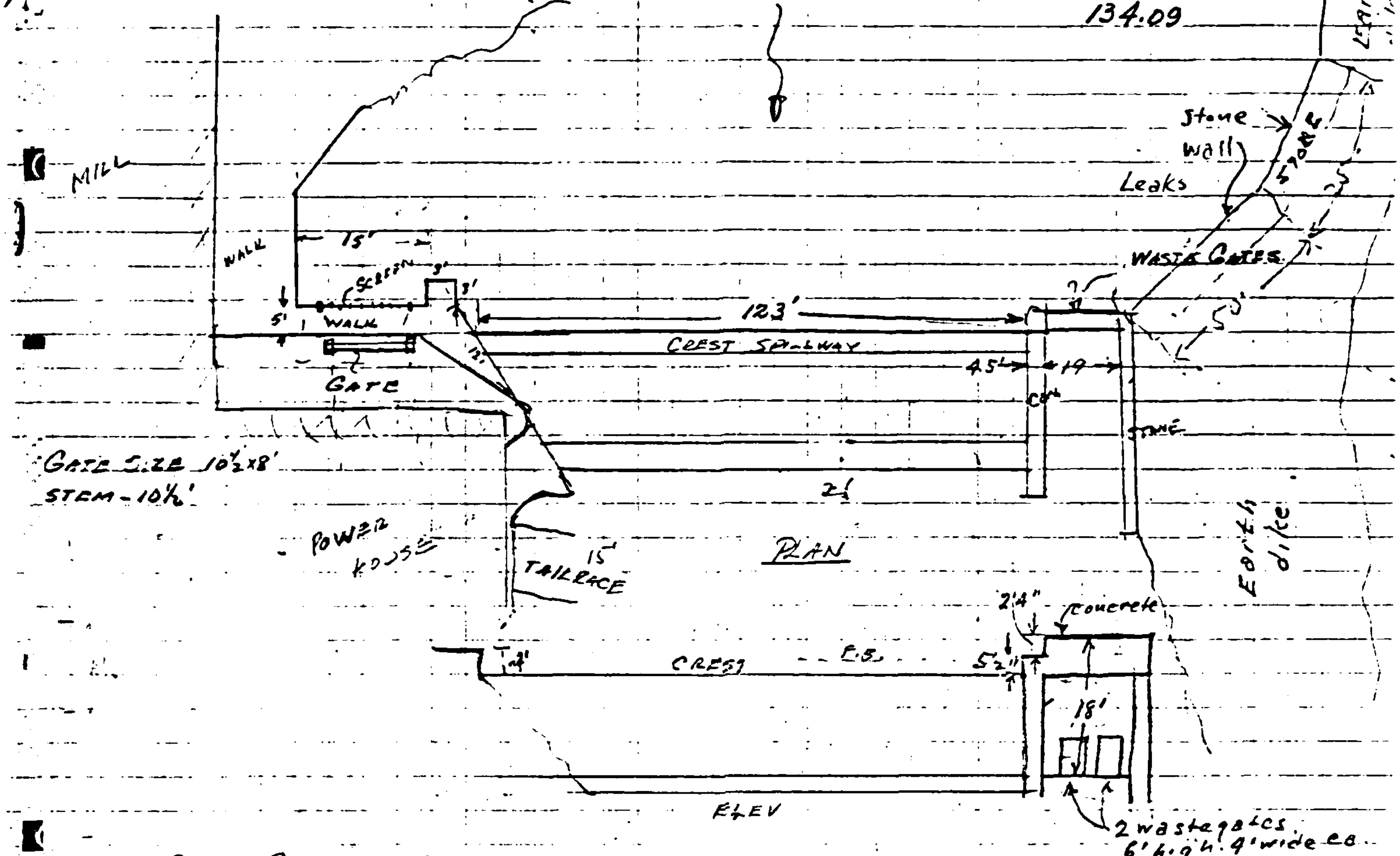
REMARKS Primary HP 90% time 184.3
Information from Wheeler, Master Mechanic who showed us some old blueprints and rowed me over to left bank. Have to use boat to reach waste gates to open them. Water level kept top of flashboards. Are building big steam plant.

DATE 1922 PSC 1931 AE

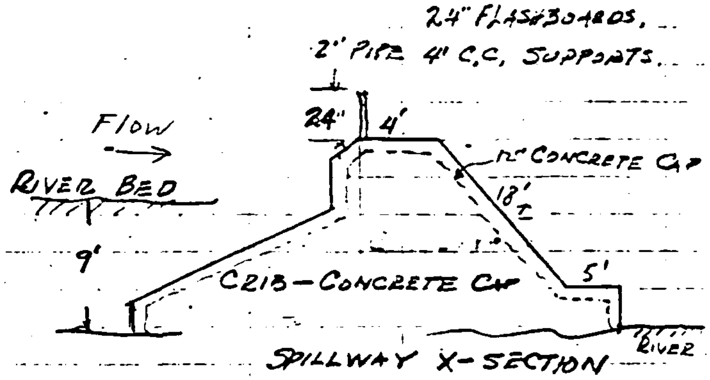
9/8/37
HR + J.H.S.



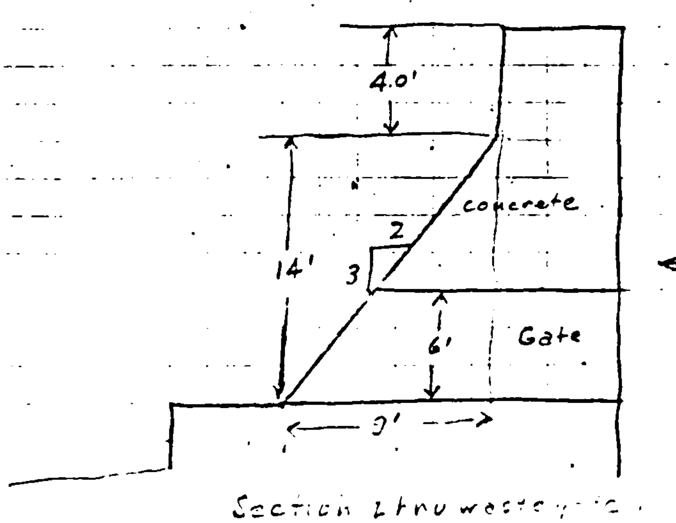
A 9/8/37 AMERICAN WOOLEN CO. PHOTO # 12-1



TYPE - CRIB - CONCRETE CAPPED (1925)
CONDITION - VERY GOOD
FOUNDATION -



Information from Wheeler Master Mechanic



Section thru wastegate

Lebanon (Grafton)
Page 6, #7

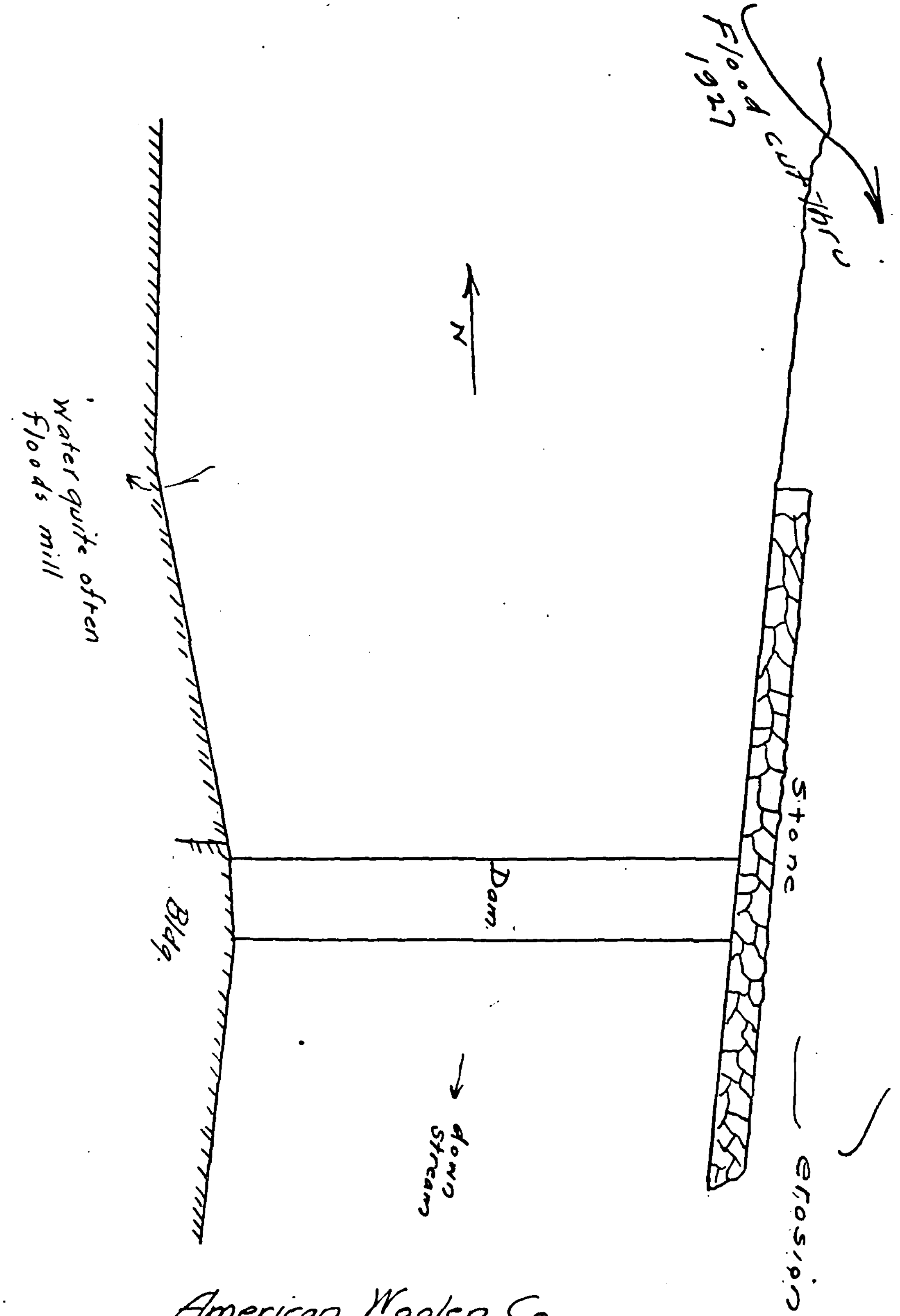
Inspected July 2, 1930.

American Woolen Company

This dam was rebuilt in 1925. About 16 foot head with 350 horse power. Has concrete wing walls. The east side wall is masonry. The rack head wall is in badly battered conditon. This is shown in the picture DIVI-95 which is on the west wing wall and shows the condition of the walls leading to the racks. The flood of 1927 worked around the east side of the embankment and did some erosion. I would recommend that the east wing wall and earth embankment should be fixed up to prevent any future trouble. In addition to that, the west wing walls should be repaired. There is very little. allowance for any flood flow. I would suggest a rather more thorough inspection with consequent recommendations. Sketch showing effect of 1927 flood.

DIVI-94
DIVI-95

84b.
134.09

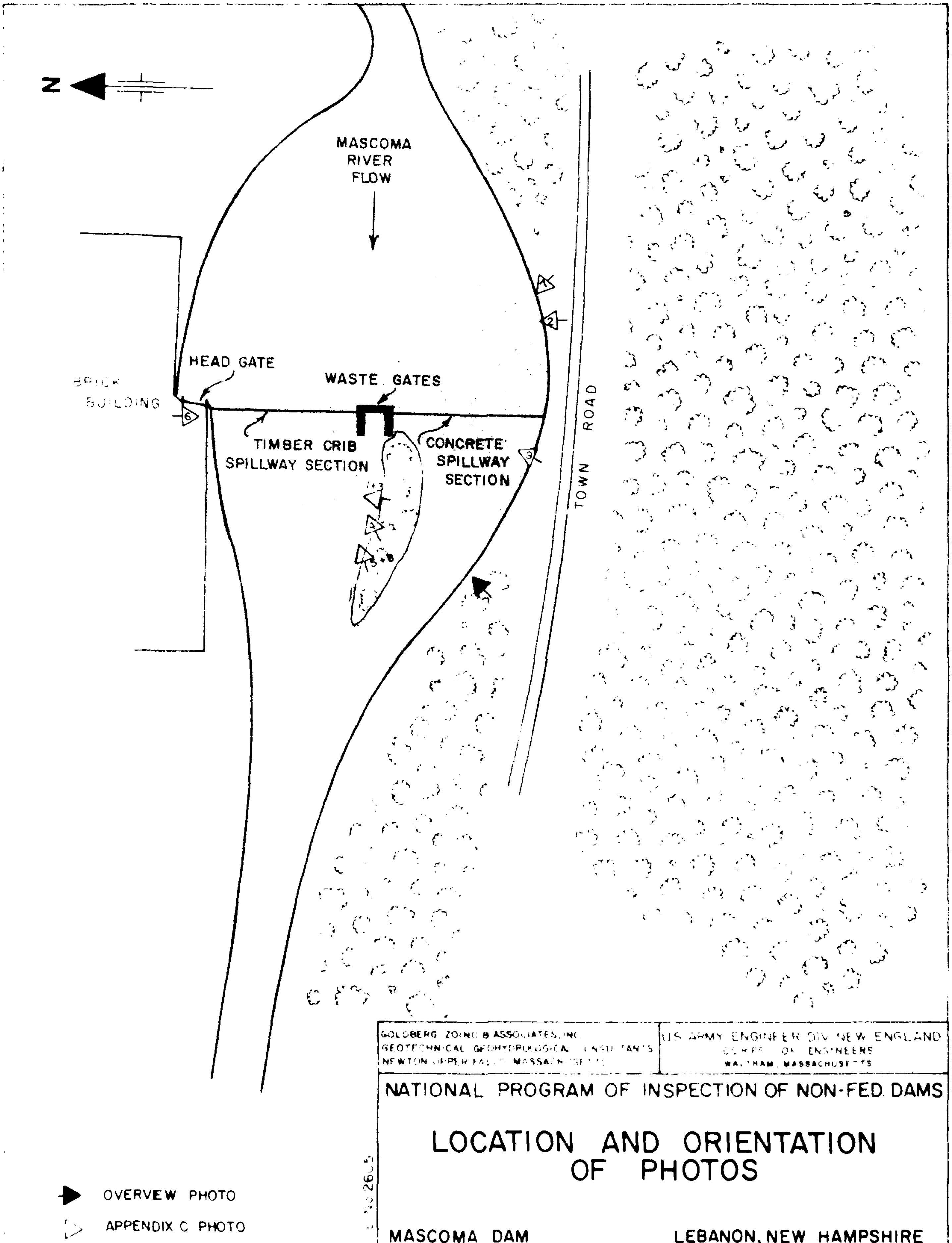


American Woolen Co.
Lebanon, N. H.

HJL
7/2/30

APPENDIX C

PHOTOGRAPHS



GOLDBERG ZOINO & ASSOCIATES, INC
GEOTECHNICAL GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS

MASCOMA DAM

LEBANON, NEW HAMPSHIRE

SCALE 1" = 100' (APPROXIMATE)

DATE JUNE 1980

1. Right Downstream Training Wall

2. Right Upstream Training Wall

3. Downstream Outlets and Mill Building

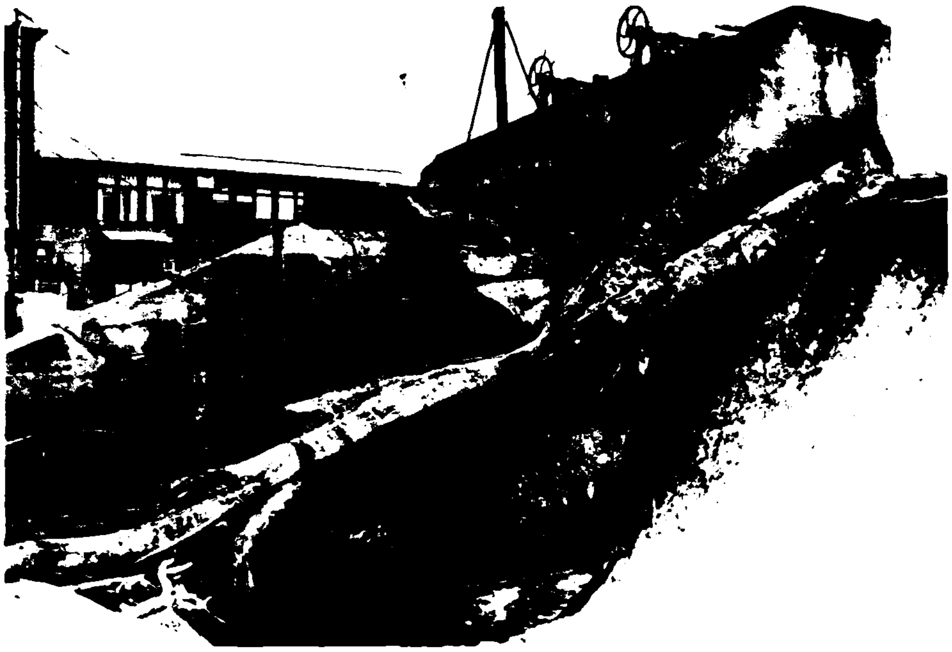
4. Right Spillway Section

5. Left Training Wall of Right Spillway

6. Left Training Wall of Rigth Spillway

7. Upstream View of Waste Gate Structure

8. Downstream View of Waste Gate Structure



9. Right Training Wall of Left Spillway

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MASCOMA DAM

RHF
5/28/80

Dam Rating Curve

A schematic sketch of the overflow section of this dam is shown on the next page. This sketch is based on the N.H.W.R.B., "Inventory of Dams and Water Power Developments" (1937) and on a recent field inspection.

Spillway Discharge

$$Q_1 = C\ L\ H^{1.5}$$

$C = 3.3$

$L = 2 \times 123 = 246'$

H = head on spillway crest (datum elev. 502.7 MSL)

$$Q_1 = 3.3 \times 246 \times H^{1.5}$$

Abutment Overflow

$$Q_2 = Q_{\text{left abutment}} + Q_{\text{left side-slope}}$$
$$+ Q_{\text{right abutment}} + Q_{\text{over waste gate structure}}$$

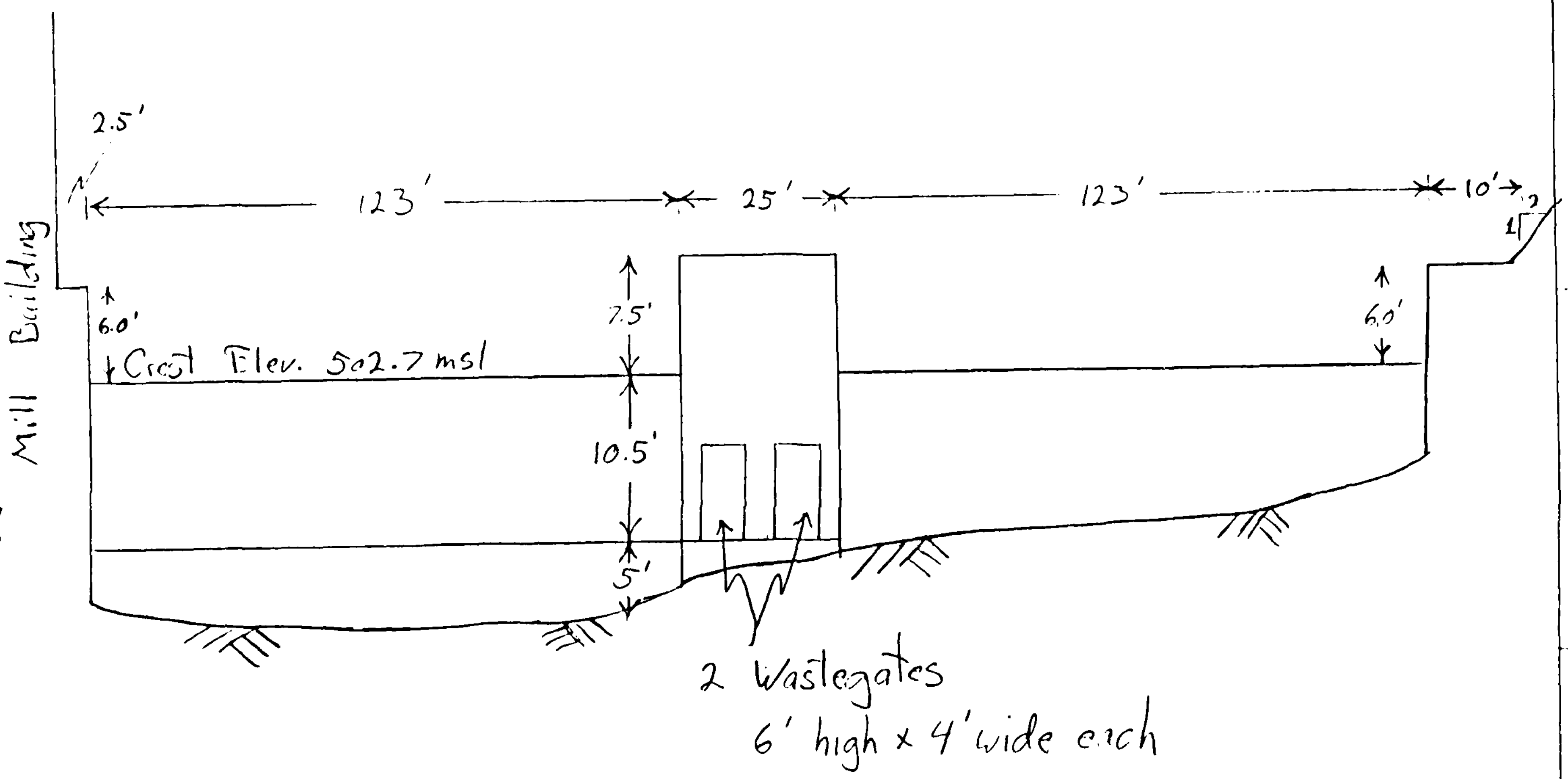
Left Abutment

$C = 3.1$

$L = 10.0'$

head $= H - 6$

$$Q = 3.1 \times 10 \times (H - 6)^{1.5}$$



SCHEMATIC of MASCOMA DAM (looking upstream)
Not to Scale

Based on N.H.W.R.B., "Inventory of Dams..." and field measurements.

MASCOMA DAM

RHF
5/28/80

Left Side-Slope

$$C = 2.8$$

$$L = 2 \times (H - 6)$$

$$\text{head} = (0.5 \times (H - 6))$$

$$Q = 2.8 \times (2 \times (H - 6)) \times (0.5\ (H - 6))^{1.5}$$

Right Abutment

$$C = 3.1$$

$$L = 2.5'$$

$$\text{head} = H - 6$$

$$Q = 3.1 \times 2.5 \times (H - 6)^{1.5}$$

Flow Over Waste Gate Structure

$$C = 3.3$$

$$L = 25'$$

$$\text{head} = H - 7.5$$

$$Q = 3.3 \times 25 \times (H - 7.5)^{1.5}$$

Total Abutment Overflow

$$Q_2 = 3.1 \times 10 \times (H - 6)^{1.5} + 2.8 \times (2 \times (H - 6)) \times (0.5(H - 6))^{1.5} + 3.1 \times 2.5 \times (H - 6)^{1.5} + 3.3 \times 25 \times (H - 7.5)^{1.5}$$

MASCOMA DAM

RHF
5/29/80

Waste Gates and Penstock Gate

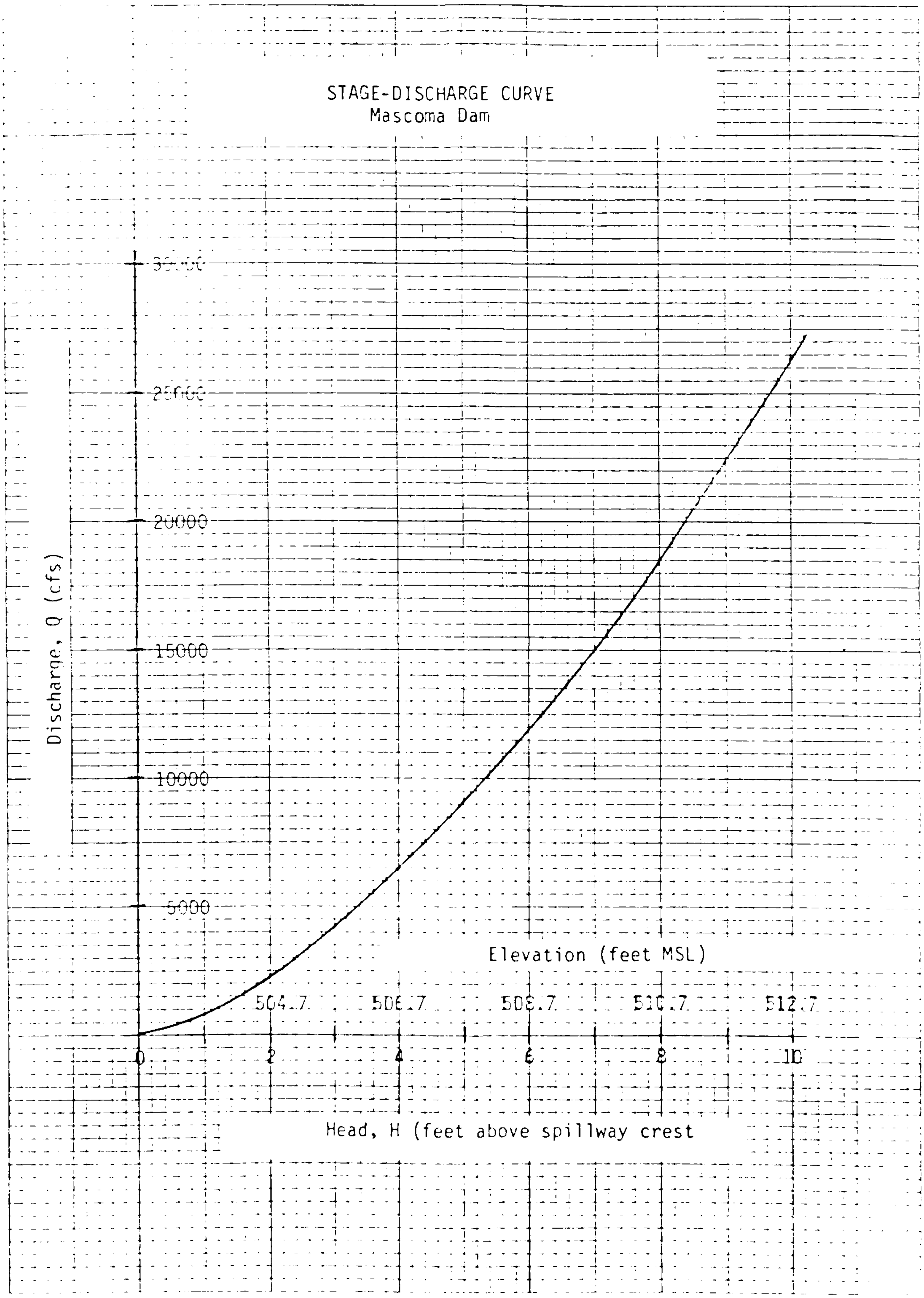
Q_3 = 0 (these gates are normally closed).

A BASIC program was written to calculate the head-discharge function at the dam. A listing of this program is shown on the next page, followed by tabulated output and a plotted curve.

```
LIST
100 REM - HEAD-DISCHARGE CURVE FOR MASCOMA DAM
110 REM - STORED ON TAPE 1Ø FILE 57
120 PAGE
130 PRINT USING 14Ø:
140 IMAGE 2ØT"HEAD VS. DISCHARGE FOR MASCOMA DAM"
150 PRINT USING 16Ø:
160 IMAGE //12T"HEAD" 35T"DISCHARGE"
170 PRINT USING 18Ø:
180 IMAGE 11T"(FEET)" 37T"(CFS)"
190 PRINT USING 2ØØ:
200 IMAGE 23T"TOTAL      SPILLWAY   ABUTMENTS   GATES"
210 PRINT " "
220 FOR H=Ø TO 1Ø STEP Ø.5
230 O1=3.3*246*H↑1.5
240 O2=Ø
250 O3=Ø
260 IF H<6 THEN 31Ø
270 O2=3.1*2.5*(H-6)↑1.5+3.1*1Ø*(H-6)↑1.5
280 O2=O2+2.8*(2*(H-6))*(Ø.5*(H-6))↑1.5
290 IF H<7.5 THEN 31Ø
300 O2=O2+3.3*25*(H-7.5)↑1.5
310 T1=O1+O2+O3
320 PRINT USING 33Ø:H,T1,O1,O2,O3
330 IMAGE 12T,2D.1D,12D,12D,1ØD,1ØD
340 NEXT H
350 END
```

HEAD VS. DISCHARGE FOR MASCOMA DAM

HEAD (FEET)	DISCHARGE (CFS) TOTAL	SPILLWAY	ABUTMENTS	GATES
0.0	0	0	0	0
0.5	287	287	0	0
1.0	812	812	0	0
1.5	1491	1491	0	0
2.0	2296	2296	0	0
2.5	3209	3209	0	0
3.0	4218	4218	0	0
3.5	5316	5316	0	0
4.0	6494	6494	0	0
4.5	7749	7749	0	0
5.0	9076	9076	0	0
5.5	10471	10471	0	0
6.0	11931	11931	0	0
6.5	13467	13453	14	0
7.0	15075	15035	41	0
7.5	16751	16674	77	0
8.0	18519	18369	150	0
8.5	20373	20118	255	0
9.0	22302	21919	384	0
9.5	24303	23770	532	0
10.0	26371	25671	699	0


STAGE-DISCHARGE CURVE
Mascoma Dam
Discharge, Q (cfs)
25000
20000
15000
10000
5000
Elevation (feet MSL)
504.7
506.7
508.7
510.7
512.7
0
2
4
6
8
10
Head, H (feet above spillway crest

MASCOMA DAM

RHF
5/29/80

Dam Failure Analysis

Consider two cases of dam failure:

I Dam failure with "normal" pool

II Dam failure with "maximum" pool

Case I - Normal Pool

Average discharge at USGS gage 5.2 miles upstream

D.A. = 153 miles^2

Q_{avg} = 215 cfs (reported 1977) = 215/153 = 1.4 csm

Average discharge at dam

Use Q_{avg} = 1.4 x 188 = 263 cfs

Assume that the dam fails with a normal outflow of 260 cfs and a pool level 0.5' above the spillway crest (from Dam Rating).

Tailwater Level at Failure

Assume that the tailwater level is controlled by uniform flow depth in the stream channel just below the dam.

MASCOMA DAM

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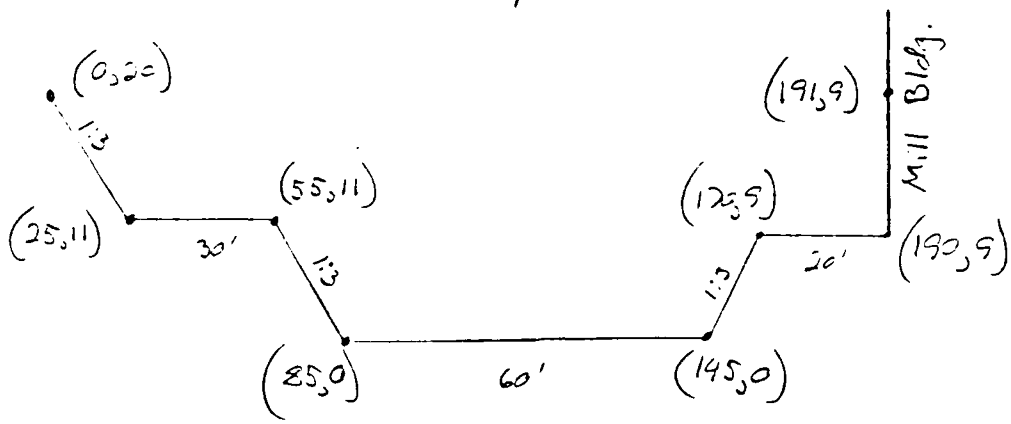
Mascoma R. 150' d/s of Mascoma Dam



Main Channel : n = 0.04   Slope : S = 0.003
Overbank : n = 0.1

A uniform flow rating table based on the section sketched above is shown on the next page. This was calculated using a simple BASIC program.

Q = 260 cfs → Depth ≈ 1.5'

Under these conditions the tailwater would be approximately 14' below the spillway crest or 14.5' below the headwater level.

===== DATA FOR THE COMBINED SYSTEM =====

DEPTH ft.	ELEV ft.	AREA ft↑2	WPER ft.	HYD-R ft.	AR2/3	Q cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	62.8	65.9	1.0	60.8	124.0
2.00	2.0	131.0	71.7	1.8	195.8	399.5
3.00	3.0	204.8	77.6	2.6	391.1	798.0
4.00	4.0	284.0	83.4	3.4	642.8	1311.6
5.00	5.0	368.8	89.3	4.1	949.5	1937.3
6.00	6.0	459.1	95.1	4.8	1310.9	2674.8
7.00	7.0	554.9	101.0	5.5	1727.6	3525.0
8.00	8.0	656.2	106.9	6.1	2200.3	4489.5
9.00	9.0	763.0	112.7	6.8	2730.1	5570.5
10.00	10.0	893.9	136.6	6.5	3127.1	6882.9
11.00	11.0	1027.7	140.5	7.3	3871.8	3329.9
12.00	12.0	1194.3	174.5	6.8	4305.4	10068.4
13.00	13.0	1363.8	178.4	7.6	5291.5	11966.8
14.00	14.0	1536.1	182.4	8.4	6358.7	14013.8
15.00	15.0	1711.4	186.4	9.2	7504.8	16203.4
16.00	16.0	1889.4	190.3	9.9	8728.0	18530.9
17.00	17.0	2070.4	194.3	10.7	10026.7	20992.9
18.00	18.0	2254.2	198.2	11.4	11399.7	23586.5
19.00	19.0	2440.9	202.2	12.1	12846.0	26309.4
20.00	20.0	2630.5	206.1	12.8	14364.6	29159.6

STREAM RATING MASCOMA R. 150 FT. D/S OF MASCOMA DAM

MASCOMA DAM

RHF
5/29/80

Breach Outflow

$Q_{p1} = 8/27 \times W_b \times \sqrt{g} \times Y_o^{3/2}$

W_b = width of breach

$\leq 0.4 \times$ (width of dam at 1/2 height)

$\leq 0.4 \times 275$

Use W_b = 100'

Y_o = pool elevation - tailwater elevation = 14.5'

$Q_{p1} = 8/27 \times 100 \times \sqrt{g} \times 14.5^{1.5} = \underline{\underline{9283}}$ cfs

Total Outflow

$Q_{tot} = 260 + 9280 = \underline{\underline{9540}}$ cfs

Case II - Maximum Pool

Assume that the dam fails with the pool at the level of the abutments -- 6.0' above the spillway crest and 21.5' above the streambed.

Normal Outflow at Failure

Q = 11930 cfs (dam rating table with H = 6.0').

MASCOMA DAM

RHF
5/29/80

Tailwater Level at Failure

At this discharge the backwater effect from the Plant No. 1 Dam 1/2 mile downstream may reach the Mascoma Dam. However, it will be conservative to ignore this effect (assuming, perhaps, that the Plant No. 1 Dam, which is in poor condition, has been removed or damaged by the flood).

Assume that the tailwater is controlled by uniform flow depth and use the stream rating table presented previously.

$Q = 11930$ cfs $\rightarrow$ Depth $\approx$ 13.0'

Under these conditions the tailwater would be approximately 2.5' below the spillway crest of 8.5' below the headwater level.

Breach Outflow

Use $W_b = 100'$

$Y_o = 8.5'$

$Q_{p1} = 8/27 \times 100 \times \sqrt{g} \times 8.5^{1.5} = \underline{4166}$ cfs

Total Outflow

$Q_{tot} = 11930 + 4170 = \underline{16100}$ cfs

MASCOMA DAM

RHF
5/29/80

Volume Impounded by the Dam (from COE inventory)

Case I: Dam failure with "normal" pool

Vol = 170 acre-ft.

Case II: Dam failure with "maximum" pool

Vol = 210 acre-ft.

Downstream Flooding

Case I - Failure at Normal Pool

Immediately downstream of the dam there is a mill/factory building at the right bank.

Prior to Failure

Depth ≈ 1.5' at Q = 260 cfs (from Stream Rating Table)

After Failure

Depth ≈ 11'-12' at Q = 9540 cfs

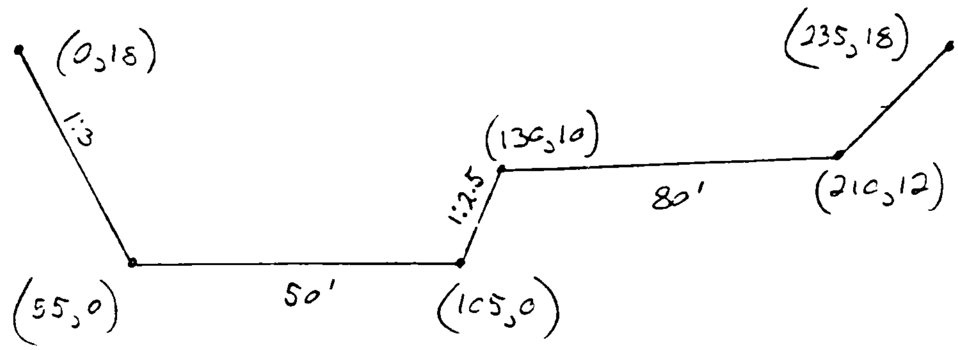
Such a flood would reach the level of windows at the (upstream) portion of the building which lines the stream. Flooding 2'-3' deep would be experienced at the downstream extension of this building.

MASCOMA DAM

RHF
5/29/80

Reach from Mascoma Dam to Plant No. 1 Dam

A rating table for this reach of the Mascoma River, based on the approximate typical section sketched below, is shown on the next page.



Main Channel: n=0.4   Overbank: n=0.1
Slope: S = 0.005

Mascoma R. 750' D/S of Mascoma Dam

Prior to Failure

Depth ≈ 1.5' at Q = 260 cfs

After Failure

Depth ≈ 11'-12' at Q = 9540 cfs

A warehouse elevated approximately 12' above the streambed and construction equipment stored nearby at the right bank about 750' downstream of the dam might incur minor flood damage.

===== DATA FOR THE COMBINED SYSTEM =====

DEPTH ft.	ELEV ft.	AREA ft↑2	WPER ft.	HYD-R ft.	AR2/3	Q cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	52.8	55.9	0.9	50.8	133.8
2.00	2.0	111.1	61.8	1.8	164.3	432.7
3.00	3.0	175.0	67.7	2.6	329.5	868.0
4.00	4.0	244.4	73.6	3.3	544.0	1432.9
5.00	5.0	319.4	79.5	4.0	807.1	2126.1
6.00	6.0	400.0	85.4	4.7	1119.4	2948.5
7.00	7.0	486.1	91.4	5.3	1481.6	3902.8
8.00	8.0	577.8	97.3	5.9	1895.2	4992.1
9.00	9.0	675.0	103.2	6.5	2361.3	6219.9
10.00	10.0	777.8	109.1	7.1	2881.4	7590.1
11.00	11.0	904.9	152.3	5.9	2968.2	9243.3
12.00	12.0	1075.0	195.5	5.5	3348.7	11098.2
13.00	13.0	1270.3	203.0	6.3	4313.1	13205.5
14.00	14.0	1472.8	210.5	7.0	5387.1	15532.7
15.00	15.0	1682.5	218.0	7.7	6570.3	18073.1
16.00	16.0	1899.4	225.5	8.4	7862.8	20823.6
17.00	17.0	2123.6	233.0	9.1	9265.1	23783.0
18.00	18.0	2355.0	240.5	9.8	10778.1	26951.2

STREAM RATING MASCOMA R. 750 FT. D/S OF MASCOMA DAM

MASCOMA DAM

RHF
5/29/80

Estimate Peak Dam Break Flow at Plant No. 1 Dam Approximately 0.5 Mile Downstream of the Dam

Follow (essentially) COE "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs."

Use the stream rating table for this reach shown previously.

Storage in Reach vs. Outflow

Assume channel storage of the flood wave equal to the reach length times the average of the upstream flow area minus normal (pre-failure) flow area and the downstream flow area minus normal flow area.

$$\text{Vol} = \left(\left(\frac{A_1 + A_2}{2}\right) - A_{norm}\right) \times L/43560$$

where:

$A_1 = 932^{ft^2}$ (upstream flow area from Stream Rating w/Q = 9540)

$A_2 = f(Q_2)$ (downstream flow area from Stream Rating)

$A_{norm} = 77^{ft^2}$ (normal flow area, Q = 260)

L = 0.5 x 5280 = 2640' (length of reach)

The flood wave peak outflow from the reach is equal to the total peak outflow minus the normal flow.

MASCOMA DAM

RHF
5/29/80

$Q_{p2} = Q_2 - Q_{normal}$ (downstream flood wave peak discharge)

Q_2 = total downstream peak discharge

Q_{normal} = 260 (normal discharge)

Channel Storage vs. Downstream Discharge Table (computed from the relationships outlined above)

Q_2	D_2	A_2	Vol	Q_{p2}
6220	9	675	44.0	5960
7590	10	778	47.1	7330
9243	11	905	51.0	8983

Attenuated Peak Outflow from Reach

$$Q_{p2} = Q_{p1} \left(1 - \frac{Vol}{S}\right)$$

$Q_{p2} = Q_2 - Q_{normal}$ (flood wave outflow)

$Q_{p1} = Q_1 - Q_{normal} = 9540 - 260 = 9280$ cfs

S = 170 AF (storage behind dam)

$$Q_{p2} = 9280 \left(1 - \frac{Vol}{170}\right)$$

MASCOMA DAM

RHF
5/29/80

Volume Required for Attenuation

$$\text{Vol} = 170\ (1 - \frac{Q_{p2}}{9280})$$

Trial & Error Solution of Q_{p2}

Storage in reach at correct value of Q_{p2} equals volume required for attenuation to that value.

Guess Q_{p2} = 7330 cfs

$$\text{Vol} = 170\ (1 - \frac{7330}{9280}) = 35.7 \text{ AF}$$

Guess Q_{p2} = 6800 cfs

$$\text{Vol} = 170\ (1 - \frac{6800}{9280}) = 45.4 \text{ AF} \quad \text{OK}$$

Then,

Q_2 = 260 + 6800 = 7060 cfs

Plant No. 1 Dam

The timber decking is in poor shape and might be damaged by such a flood. The concrete abutments and buttresses probably would not be harmed.

Plant No. 1 Dam is considered LOW hazard. Total failure would not result in siginificant damage downstream.

RESOURCE ANALYSIS
a Camp Dresser & McKee

MASCOMA DAM

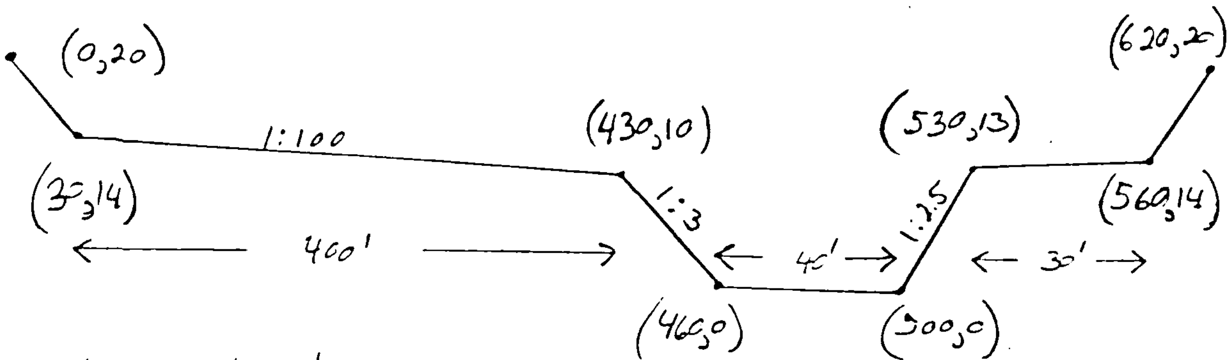
RHF
5/29/80

Slayton Hill Rd. Bridge

Slayton Hill Rd. crosses the Mascoma River approximately 150' upstream of Plant No. 1 Dam. The low chord is 12' above the crest of the dam (elev. 500), so the bridge should not be damaged by flooding.

Reach from Plant No. 1 Dam to Machanic Street

A rating table based on the section sketched below is shown on the next page.



Main Channel
n = 0.04
Overbank
n = 0.1

Slope S = 0.006

Prior to Failure

Depth = 1.5' at Q = 260 cfs (Stream Rating)

===== DATA FOR THE COMBINED SYSTEM =====

DEPTH ft.	ELEV ft.	AREA ft↑2	WPER ft.	HYD-R ft.	AR2/3	Q cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	1.0	42.7	45.7	0.9	40.8	117.6
2.00	2.0	90.6	51.4	1.8	132.3	381.8
3.00	3.0	143.9	57.0	2.5	266.7	769.4
4.00	4.0	202.5	62.7	3.2	442.3	1276.2
5.00	5.0	266.3	68.4	3.9	659.3	1902.5
6.00	6.0	335.5	74.1	4.5	918.7	2650.9
7.00	7.0	410.0	79.7	5.1	1221.6	3524.9
8.00	8.0	489.8	85.4	5.7	1569.4	4528.5
9.00	9.0	575.0	91.1	6.3	1963.7	5666.2
10.00	10.0	665.4	96.8	6.9	2406.0	6942.5
11.00	11.0	809.6	199.3	4.1	2061.3	8546.9
12.00	12.0	1056.2	301.8	3.5	2434.4	10447.5
13.00	13.0	1405.0	404.3	3.5	3223.3	12740.1
14.00	14.0	1870.0	534.4	3.5	4310.4	15713.5
15.00	15.0	2407.5	549.5	4.4	6446.1	19489.9
16.00	16.0	2960.0	564.7	5.2	8932.4	23805.4
17.00	17.0	3527.5	579.8	6.1	11756.0	28630.6
18.00	18.0	4110.0	595.0	6.9	14908.0	33946.5
19.00	19.0	4707.5	610.1	7.7	18381.7	39740.1
20.00	20.0	5320.0	625.2	8.5	22172.8	46002.0

STREAM RATING MASCOMA R. D/S OF PLANT NO. 1 DAM

MASCOMA DAM

RHF
5/29/80

After Failure

Depth ≈ 10' at Q = 7000 cfs (Stream Rating)

Structures near the right bank shortly downstream of Plant No. 1 Dam are elevated at least 14' above the streambed and therefore would escape damage.

Estimate Peak Dam Break Flow at Mechanic Street

~ 1.0 mile downstream of Mascoma Dam (0.5 mile downstream of Plant No. 1 Dam).

Storage in Reach vs. Outflow

$$Vol = \left(\left(\frac{A_1 + A_2}{2} \right) - A_{norm} \right) \times L/43560$$

where:

$A_1 = 670$

$A_2 = f(Q_2)$

$A_{norm} = 68$

$L = 2640$

MASCOMA DAM

RHF
5/29/80

Q_2	D_2	A_2	Vol	Q_{p2}
3525	7	410	28.6	3265
4529	8	490	31.1	4269
5666	9	575	33.6	5406

Attenuated Peak Outflow From Reach

$$Q_{p2} = 6800\ (1 - \frac{Vol}{170})$$

Volume Required for Attenuation

$$Vol = 170\ (1 - \frac{Q_{p2}}{6800})$$

Trial & Error Solution of Q_{p2}

Guess Q_{p2} = 4269

Vol = 63.3

Guess Q_{p2} = 5400

Vol - 35.0

Guess Q_{p2} = 5500

Vol = 32.5

Then,

Q_2 = 5500 + 260 = 5760 cfs

Depth ≈ 9'+ at Q = 5760 cfs

MASCOMA DAM

RHF
5/29/80

Two low-lying structures near Mechanic Street at the end of this reach are elevated approximately 10' above the streambed and, so, would probably escape serious flood damage due to dam failure.

Downstream of Mechanic Street

I-89 and the B&M railroad cross the river approximately 1/2 mile downstream of Mechanic Street. These bridges are sufficiently elevated to escape flood damage. There are no other structures near the stream for 1½ miles downstream of Mechanic Street. The flood wave should not be a hazard beyond that point due to further attenuation.

Case II - Failure at Maximum Pool

Immediately downstream of the dam

Prior to Failure

Depth ≈ 13' at Q = 11930 cfs

Serious flood damage would be experienced at the mill building prior to dam failure. Flood depths at the downstream extension would be 3'-4'.

After Failure

Depth ≈ 15' at Q = 16100 cfs

MASCOMA DAM

RHF
5/29/80

A 2'± increment to the flood level downstream of the dam would result from dam failure.

Reach from Mascoma Dam to Plant No. 1 Dam

Prior to Failure

Depth = 12'-13' at Q = 11930 cfs

There would be approximately 1' of flooding at the warehouse 750'± downstream of the dam.

After Failure

Depth = 14' at Q = 16100 cfs

A 1'+ increment of flooding would result at the warehouse.

Reach from Plant No. 1 Dam to Mechanic Street

Prior to Failure

Depth = 12'-13' at Q = 11930 cfs

The structures shortly downstream of Plant No. 1 Dam would escape flooding.

Two structures in the flood plain near the Mechanic Street crossing would be flooded 1'-3'.

After Failure

Depth = 14' at Q = 16100 cfs

MASCOMA DAM

RHF
5/29/80

Attenuation would reduce the peak flood level (as illustrated in the Case I calculations) to somewhat less than 14'.

The structures shortly downstream of Plant No. 1 Dam should escape serious flood damage.

A 1'± increment to the flooding at the structures near Mechanic Street would result due to dam failure.

MASCOMA DAM

RHF
5/29/80

Test Flood Analysis

Size Classification -- SMALL

Storage < 1000 AF

Height < 40"

Hazard Classification -- HIGH

Failure of the dam under normal flow conditions would result in severe flooding (perhaps with little warning) at the mill building just downstream. This would be a serious threat to the lives of workers in the building. Failure under "maximum pool" conditions would cause an incremental increase to flood levels sustained at the mill building, and at two structures in the flood plain 1 mile downstream.

Test Flood Selection

Per COE guidelines, a SMALL dam with HIGH hazard potential should use a 1/2 PMF to PMF Test Flood. As this is a run of the river type dam, the small value is appropriate.

A 1975 Flood Insurance Study by COE NED estimated 10, 50 100, 500-year discharges for the Mascoma River in Lebanon as follows:

Recurrence Interval	Peak Discharge
10 years	3500 cfs
50	5900
100	7000
500	10,000

MASCOMA DAM

RHF
5/29/80

The 500-year peak discharge of 10,000 cfs will be used to approximate the 1/2 PMF event. This value applies at the dam, so that storage routing in the reservoir need not be considered. In any case, the surcharge storage available is too small in relation to the size of the watershed to have significant effect. For these reasons, a stage-storage function has not been calculated.

Test Flood Summary

Size: SMALL

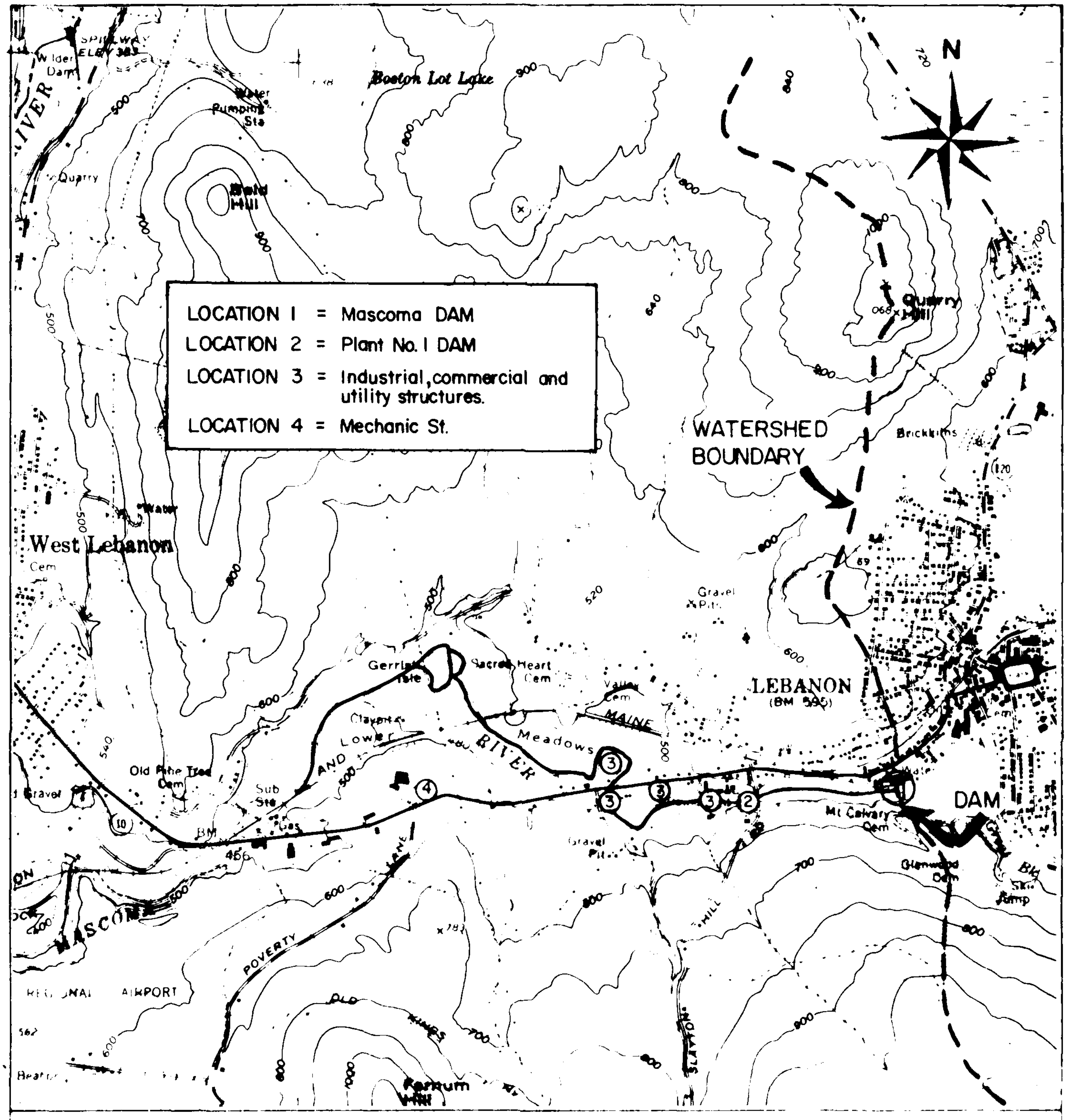
Hazard: HIGH

Test Flood: 500-year peak discharge to approximate 1/2 PMF

Q_{500} = 10,000 cfs

Head on Spillway = 5.3' (from Dam Rating)

The pool level will be approximately 0.7' below the top of the abutment walls.



0 1000 2000 4000 (FT)

FROM USGS HANOVER-N.H. QUADRANGLE MAP

GOLDBERG ZOINO & ASSOCIATES, INC GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS NEWTON UPPER FALLS, MASSACHUSETTS	US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

FILE No. 2605

MASCOMA DAM NEW HAMPSHIRE

SCALE AS NOTED

DATE JUNE 1980

APPENDIX E

INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
NH	155	NED	NH	019	02				MASCOMA DAM	4338.3	7215.4	20JUN80

POPULAR NAME	NAME OF IMPOUNDMENT
	MASCOMA RIVER

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	MASCOMA RIVER	LEBANON	2	9725

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
PGOT	1925	H	19	19	210	170	NED	N	N	N	N	

REMARKS
21-TIMBER CRIB WITH CONCRETE CAP AND CONCRETE OGEE 72 REBUILT

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	360	U	240				.2									

OWNER	ENGINEERING BY	CONSTRUCTION BY
GARLIN HUSKIN		

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
GOLDBERG ZOINO + ASSOCIATES	06MAY80	P.L. 92-367

REMARKS

END

FILMED

8-85

DTIC